

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN GERMANY

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New scientific results

- Two international intercalibration studies (co-) led by German scientists were successfully completed:
- Dissolved Si isotope intercalibration on seawater from ALOHA, led by P. Grasse (Geomar, Germany) and M. Brzezinski (USA): Grasse *et al.* (2016) (see below)
- Dissolved rare earth element intercalibration on seawater from SArFe, North Pacific, led by M. Behrens and K. Pahnke (ICBM, Germany): Behrens *et al.* (2016) (see below)

New publications (published or in press)

- Behrens, M. K., 2017. Controls on rare earth element and neodymium isotope distributions in the West Pacific: local imprint vs. lateral transport, PhD thesis, University of Oldenburg, pp. 143.
- Behrens, M.K., Muratli, J., Pradoux, C., Wu, Y., Böning, P., Brumsack, H.-J., Goldstein, S.L., Haley, B., Jeandel, C., Paffrath, R., Pena, L.D., Schnetger, B., Pahnke, K., 2016. Rapid and precise analysis of rare earth elements in small volumes of seawater - Method and intercomparison. *Marine Chemistry* 186, 110-120. doi: doi:10.1016/j.marchem.2016.08.006.
- Birchill, A.J., Milne, A., Woodward, E.M.S., Harris, C., Annett, A., Rusiecka, D., Achterberg, E.P., Gledhill, M., Ussher, S.J., Worsfold, P.J., Geibert, W., Lohan, M.C. (2017). Seasonal iron depletion in temperate shelf seas. *Geophysical Research Letters*, in press.
- Bridgestock, L., van de Flierdt, T., Rehkämper, M., Paul, M., Middag, R., Milne, A., Lohan, M.C., Baker, A.R., Chance, R., Khondoker, R., Strekopytov, S., Humphreys-Williams, E., Achterberg, E.P., Rijkenberg, M.J.A., Gerringa, L.J.A., de Baar, H.J.W., 2016. Return of naturally sourced Pb to Atlantic surface waters. *Nature Communications* 7, 12921.
- Bridgestock, L., Rehkämper, M., van de Flierdt, T., Murphy, K., Khondoker, R., Baker, A.R., Chance, R., Strekopytov, S., Humphreys-Williams, E., Achterberg, E.P., 2017. The Cd isotope composition of atmospheric aerosols from the Tropical Atlantic Ocean. *Geophysical Research Letters* 44, 2932-2940. doi: 10.1002/2017GL072748.
- Browning, T. J., Achterberg, E. P., Rapp, I., Bertrand, E. M., Engel, A., Tagliabue, A., & Moore, C. M. (Accepted). Nutrient co-limitation at the boundary of an oceanic gyre. *Nature*.
- Browning, T.J., Achterberg, E.P., Yong, Y.C., Rapp, I., Utermann, C., Engel, A, and Moore, C.M. (2017). Iron limitation of microbial phosphorus acquisition in the tropical North Atlantic. *Nature Communications*, 8, 15465, doi:10.1038/ncomms15465.
- Casacuberta, N., Masqué, P., Henderson, G., Rutgers van-der-Loeff, M., Bauch, D., Vockenhuber, C., Daraoui, A., Walther, C., Synal, H.A., Christl, M., 2016. First ^{236}U data from the Arctic Ocean and use of $^{236}\text{U}/^{238}\text{U}$ and $^{129}\text{I}/^{236}\text{U}$ as a new dual tracer. *Earth and Planetary Science Letters* 440, 127-134.

New publications (published or in press)

- Charette, M.A., Lam, P.J., Lohan, M.C., Kwon, E.Y., Hatje, V., Jeandel, C., Shiller, A.M., Cutter, G.A., Thomas, A., Boyd, P.W., Homoky, W.B., Milne, A., Thomas, H., Andersson, P.S., Porcelli, D., Tanaka, T., Geibert, W., Dehairs, F., Garcia-Orellana, J., 2016. Coastal ocean and shelf-sea biogeochemical cycling of trace elements and isotopes: lessons learned from GEOTRACES. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 374.
- Ehlert, C., Reckhardt, A., Greskowiak, J., Liguori, B.T.P., Böning, P., Paffrath, R., Brumsack, H.-J., Pahnke, K., 2016. Transformation of silicon in a sandy beach ecosystem: Insights from stable silicon isotopes from fresh and saline groundwaters. *Chemical Geology* 440, 207-218.
- Filippova, A., Frank, M., Kienast, M., Rickli, J., Hathorne, E.C., Yashayaev, I., Böning, P., Pahnke, K., 2017. Water mass circulation and weathering inputs in the Labrador Sea based on coupled Hf-Nd isotope composition and rare earth element distribution. *Geochimica et Cosmochimica Acta* 199, 164-184.
- Fröllje, H., Pahnke, K., Schnetger, B., Brumsack, H.-J., Dulai, H., Fitzsimmons, J.N., 2016. Hawaiian imprint on dissolved Nd and Ra isotopes and rare earth elements in the central North Pacific: local survey and seasonal variability. *Geochimica et Cosmochimica Acta* 189, 110-131. doi: 10.1016/j.gca.2016.06.001.
- Fröllje, H., 2016. Rare Earth Element and Neodymium Isotope Tracing of Element Input and Past Ocean Circulation: Study From North and South Pacific Seawater and Sediments. PhD thesis, University of Oldenburg, pp. 168.
- German, C.R., Casciotti, K.A., Dutay, J.C., Heimbürger, L.E., Jenkins, W.J., Measures, C.I., Mills, R.A., Obata, H., Schlitzer, R., Tagliabue, A., Turner, D.R., Whitby, H., 2016. Hydrothermal impacts on trace element and isotope ocean biogeochemistry. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 374.
- Grasse, P., Brzezinski, M., Cardinal, D., de Souza, G.F., Andersson, P., Closset, I., Cao, Z., Dai, M., Ehlert, C., Estrade, N., Francois, R., Frank, M., Jiang, G., Jones, J.L., Kooijman, E., Liu, Q., Lu, D., Pahnke, K., Ponzevera, E., Schmitt, M., Sun, X., Sutton, J., Thil, F., Weis, D., Wetzel, F., Zhang, A., Zhang, J., Zhang, Z., 2016. GEOTRACES Intercalibration of the Stable Silicon Isotope Composition of Dissolved Silicic Acid in Seawater. *Journal of Analytical Atomic Spectrometry*, 32(3), 562–578. <http://doi.org/10.1039/C6JA00302H>.

New publications (published or in press)

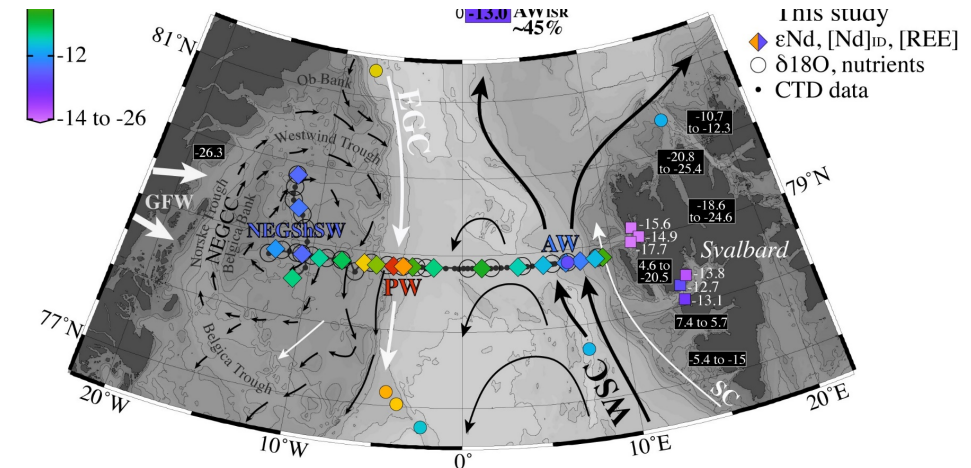
- Hopwood, M.J., Birchill, A.J., Gledhill, M., Achterberg, E.P., Klar, J., Milne A. (2017). A comparison between four analytical methods for the measurement of Fe(II) at nanomolar concentrations in coastal seawater. *Frontiers in Marine Biogeochemistry*, 4, 192. DOI=10.3389/fmars.2017.00192.
- Laukert, G., Frank, M., Bauch, D., Hathorne, E.C., Rabe, B., von Appen, W.-J., Wegner, C., Zieringer, M., Kassens, H., 2017. Ocean circulation and freshwater pathways in the Arctic Mediterranean based on a combined Nd isotope, REE and oxygen isotope section across Fram Strait. *Geochimica et Cosmochimica Acta* 202, 285-309.
- Milne, A., Schlosser, C., Wake, B.D., Achterberg, E.P., Chance, R., Baker, A.R., Forryan, A., Lohan, M.C., 2017. Particulate phases are key in controlling dissolved iron concentrations in the (sub)tropical North Atlantic. *Geophysical Research Letters* 44, 2377-2387. doi: 10.1002/2016GL072314.
- Poehle, S., Koschinsky, A., 2017. Depth distribution of Zr and Nb in seawater: The potential role of colloids or organic complexation to explain non-scavenging-type behavior. *Marine Chemistry* 188, 18-32.
- Rapp, I., Schlosser, C., Rusiecka, D., Gledhill, M., Achterberg, E.P. (2017). Automated preconcentration of Fe, Zn, Cu, Ni, Cd, Pb, Co, and Mn in seawater with analysis using high-resolution sector field inductively-coupled plasma mass spectrometry. *Analytica Chimica Acta*, 976, 1-13. DOI: 10.1016/j.aca.2017.05.008.
- Rutgers van der Loeff, M., Venchiarutti, C., Stimac, I., van Ooijen, J., Huhn, O., Rohardt, G., Strass, V., 2016. Meridional circulation across the Antarctic Circumpolar Current serves as a double ²³¹Pa and ²³⁰Th trap. *Earth and Planetary Science Letters* 455, 73-84.
- Schlitzer, R., 2016. Quantifying He fluxes from the mantle using multi-tracer data assimilation. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 374.
- Xie, R., Galer, S.G., Abouchami, W., Rijkenberg, M., de Baar, H., De Jong, J., Andreae, M.O., in press. Non-Rayleigh control of upper-ocean Cd isotope fractionation in the western South Atlantic. *Earth and Planetary Science Letters*.

PhD theses

- Henning Fröllje (summa cum laude), 2016, Rare Earth Element and Neodymium Isotope Tracing of Element Input and Past Ocean Circulation: Study From North and South Pacific Seawater and Sediments. ICBM University of Oldenburg (Supervisor: K. Pahnke)
- Melanie Behrens, 2017, Controls on rare earth element and neodymium isotope distributions in the West Pacific: local imprint vs. lateral transport. ICBM University of Oldenburg (Supervisor: K. Pahnke)
- Georgi Laukert (summa cum laude), 2017, Ocean circulation and shelf processes in the Arctic Mediterranean traced by radiogenic neodymium isotopes, rare earth elements and stable oxygen isotopes. University of Kiel (Supervisor: M. Frank)
- Sandra Pöhle, 2017. Input and Particle Reactivity of Transition Metals from subgroups IV, V and VI in the water column of the Atlantic Ocean. Jacobs University Bremen (Supervisor: A. Koschinsky)

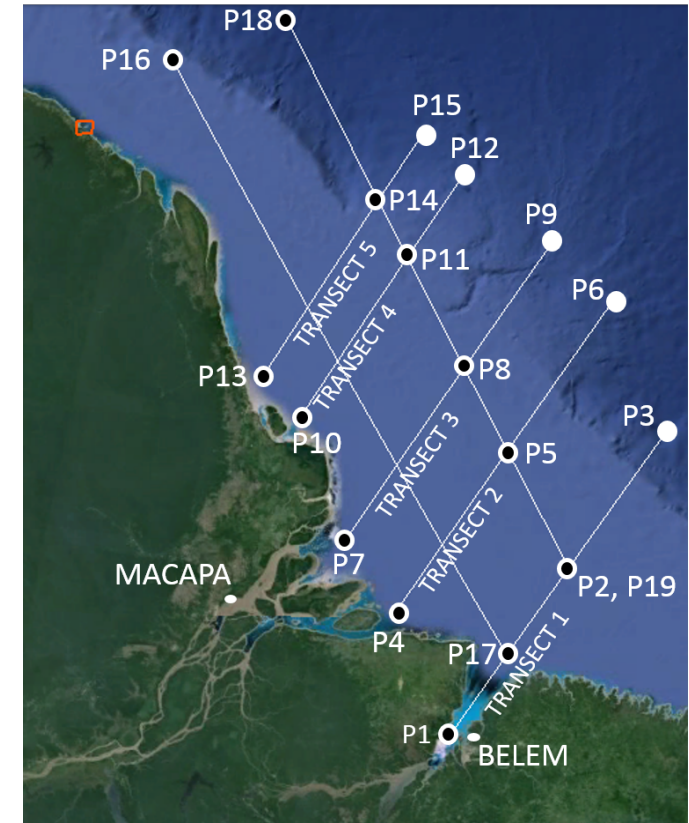
Completed Cruises

- **GEOTRACES Process Study GPpr09**, R/V Sonne cruise SO245 to the oligotrophic South Pacific gyre (Antofagasta, Chile-Wellington, New Zealand, Dec. 17, 2015 – Jan. 28, 2016). Chief-Scientist: Tim Ferdelman, MPI Bremen, GEOTRACES PIs: Katharina Pahnke (ICBM, Oldenburg), Peter Croot (Galway), Bob Anderson (LDEO).
- **GEOTRACES Section GN05**, R/V Polarstern cruise PS100 to the Fram Strait (Tromsø-Tromsø, Norway, July 18-Sept. 6, 2016). Chief-Scientist: Torsten Kanzow, AWI. GEOTRACES PIs: Michiel Rutgers van der Loeff, Walter Geibert (AWI), Eric Achterberg and Martin Frank (Geomar), Loes Gerringa (NIOZ).



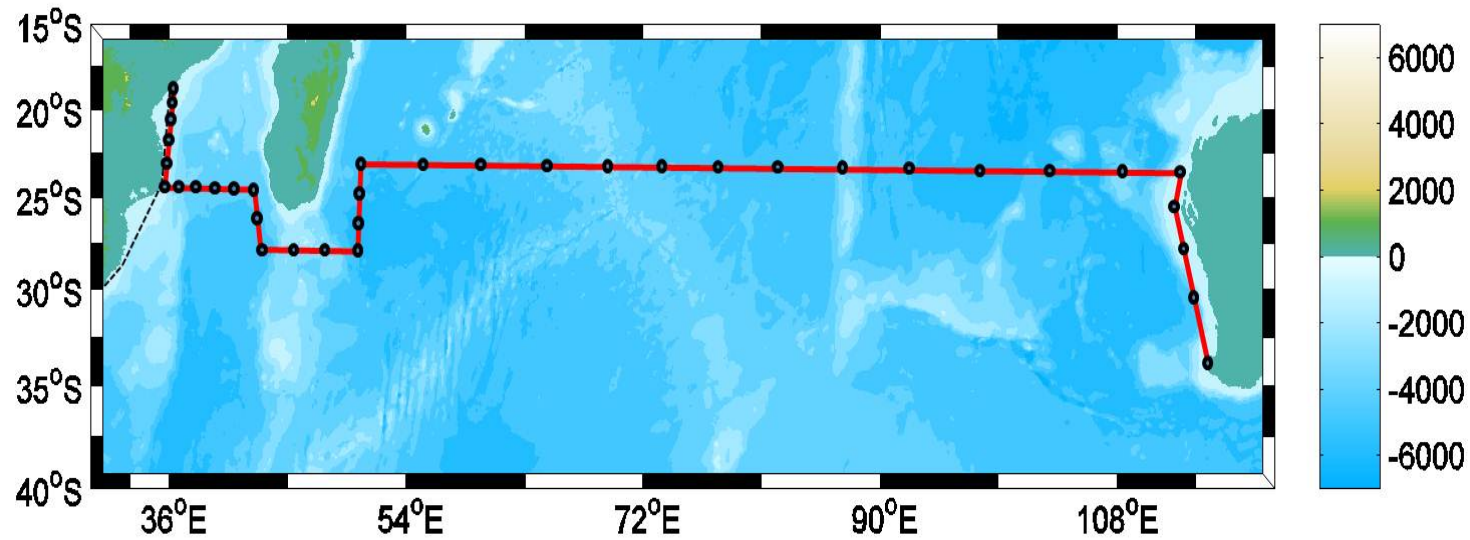
Upcoming cruises

- M147: Detailed study on trace metals and dissolved organic matter in the Amazon estuary and in the associated plume of the freshwater discharge into the Atlantic Ocean (RV Meteor)
- Andrea Koschinsky (main PI), Thorsten Dittmar, Martin Frank, Martha Gledhill, Eric Achterberg.
- April 2018.
- The cruise will be proposed to GEOTRACES as a process study.



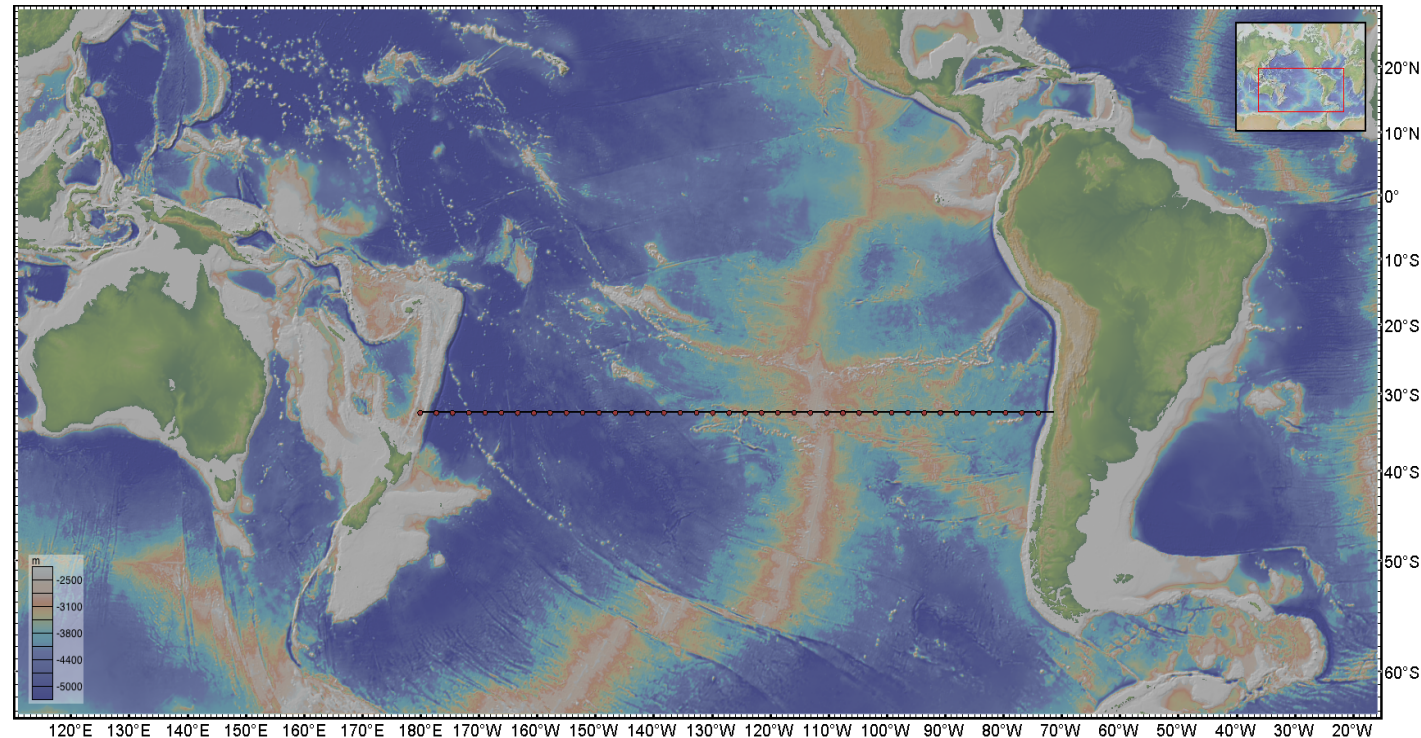
Upcoming cruises

- South Indian Ocean cruise section cruise (GIO6, along 23°S).
- Not in 2018, hopefully 2019.



Cruise proposal. Submission 30 Sept

- Cruise proposal written now for South Pacific along 32.5° S, linking up with GP13. Cruise will be along WOCE line P6. Perhaps 2020.....
- Pls Achterberg, Frank, Koschinsky



Deep Water Reference Material

- Only one group provided data following distribution of the deep water collected in the Angola Basin
- Now further groups have been approached, and following receipt of more data and indication of sample stability, we will distribute
- Hopefully by early 2018!!!!