

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN UNITED KINGDOM

June 1st, 2015 to April 30th, 2016

New results

- One process cruises GApr04 Leg 3- Shows clear seasonal cycle of Fe, where Fe is limiting during summer months, a surprising result in a shelf system. Clear signal of remineralisation was Fe observed and this was offset from nitrate.
- Pb isotopes have revealed that significant proportions of up to 30 – 50% of natural Pb, derived from mineral dust, are observed in Atlantic surface waters, reflecting the success of the global effort to reduce anthropogenic Pb emissions (Bridgestock et al. submitted).
- Modelling- Alessandro Tagliabue and co-workers produced a critical intercomparison of 13 global ocean biogeochemistry models to investigate how these models simulate dissolved iron distributions using data from IDP2014 (Tagliabue et al., 2016).

New publications

- Aumont, O., Ethé, C., Tagliabue, A., Bopp, L. & Gehlen, M. (2015) PISCES-v2: an ocean biogeochemical model for carbon and ecosystem studies, *Geoscientific Model Development*, 8, 2465-2513, doi: 10.5194/gmd-8-2465-2015.
- Bratkič, A., Vahčić, M., Kotnik, J., Vazne, K.O., Begu, E., Woodward, E.M.S. & Horvat, M. (2016). Mercury presence and speciation in the South Atlantic Ocean along the 40°S transect: *Global Biogeochem. Cycles*, 30, 105–119.
- Casacuberta, N., Masqué, P., Henderson, G., Rutgers van-der-Loeff, M., Bauch, D., Vockenhuber, C., Daraoui, A., Walther, C., Synal, H.A. and Christl, M. (2016) First 236U data from the Arctic Ocean and use of 236U/238U and 129I/236U as a new dual tracer. *Earth Planet. Sci. Lett.* 440, 127-134.
- Chance, R., Jickells, T. & Baker, A.R. (2015). Atmospheric trace metal concentrations, solubility and deposition fluxes in remote marine air over the south-east Atlantic. *Mar. Chem.* 177: 45-66
- Floor, G.H., Clough, R., Lohan, M.C, Ussher, S.J. & Worsfold, P.J. (2015). Combined uncertainty estimation for the determination of the dissolved iron amount content in seawater using flow injection with chemiluminescence detection. *Limonol. Oceanogr. Methods*, doi:10.1002/lom3.10057
- Lambert, F., Tagliabue, A., Shaffer, G., Lamy, F., Winckler, G., Farias, L., Gallardo, L., De Pol-Holz, R. (2015). Dust fluxes and iron fertilization in Holocene and Last Glacial Maximum climates, *Geophysical Research Letters*, doi: 10.1002/2015GL064250.
- Lambelet, M., van de Flierdt, T., Crocket, K., Rehkämper, M., Kreissig, K., Coles, B., Rijkenberg, M.J.A., Gerringa, L.J.A., de Baar, H.J.W., & Steinfeldt, R. (2016). Neodymium isotopic composition and concentration in the western North Atlantic Ocean: Results from the GEOTRACES GA02 section. *Geochim. Cosmochim. Acta* 177, 1-29.
- Lambelet, M., Crocket, K.C., Kreissig, K., Coles, B., & Auro, M.E. (2015). Neodymium isotope analyses after combined extraction of actinide and lanthanide elements from

seawater and deep-sea coral aragonite. *Geochem. Geophys. Geosyst.* 16, doi:10.1002/2015GC006130.

- Murphy, K., Rehkämper, M., Kreissig, K., Coles, B., van de Flierdt, T. (2016). Improvements in Cd stable isotope analysis achieved through use of liquid-liquid extraction to remove organic residues from Cd separates obtained by extraction chromatography. *J. Anal. At. Spectrom.* 31, 319-327.
- Osborne A. H., Haley B. A., Hathorne E. C., Plancherel Y. and Frank M. (2015). Rare earth element distribution in Caribbean seawater: Continental inputs versus lateral transport of distinct REE compositions in subsurface water masses. *Marine Chemistry.* doi:10.1016/j.marchem.2015.03.013
- Paul, M., van de Flierdt, T., Rehkämper, M., Khondoker R., Weiss, D., Lohan, M.C., & Homoky, W.B. (2015). Seawater Lead Isotopes Trace Agulhas Leakage. *Geophys. Res. Lett.*, 42
- Powell, C.F., Baker, A.R., Jickells, T.D., Bange, H.W., Chance, R.J. & Yodle, C. (2015). Estimation of the atmospheric flux of nutrients and trace metal to the Eastern Tropical North Atlantic Ocean. *J. of Atmospheric Sciences*, 72: 4029-4045
- Resing, J.A., Sedwick, P.N., German, C.R., Jenkins, W.J., Moffat, J.W., Sohst B.M. & Tagliabue, A. (2015). Basin-scale transport of hydrothermal dissolved metals across the South Pacific Ocean, *Nature*, doi:10.1038/nature14577.
- Rogan, N., Achterberg, E.P., Le Moigne, F.A.C., Marsay, C.M., Tagliabue, A., & Williams, R.G. (2016). Volcanic ash as an oceanic iron source and sink, *Geophysical Research Letters*, 43(6), 2732-2740. doi:10.1002/2016gl067905
- Snow, J.T., Schlosser, C., Woodward, E.M.S., Mills, M.M., Achterberg, E.A., Mahaffey, C., Bibby, T. & Moore, C.M. (2015). Environmental controls on the biogeography of diazotrophy and Trichodesmium in the Atlantic. *Global Biogeochemical Cycles* doi:10.1002/2015GB005090
- Struve, T., van de Flierdt, T., Robinson, L.F., Bradmiller, L.I., Hines, S.K., Adkins, J.F., Tagliabue, A., Aumont, A., DeAth, R., Dunne, J.P., Dutkiewicz, S., Galbraith, E., Misumi, K., Ridgwell, A., Sherman, E., Stock, C., Vichi, M., Volker, C. & Yool, A. (2016). How well do global ocean biogeochemistry models simulate dissolved iron distributions?, *Global Biogeochemical Cycles.* doi:10.1002/2015gb005289, 2016.
- Tuerena, R. E., R. S. Ganeshram, Geibert, W., Fallick, A.E., Dougans, J., Tait, A., Henley, S.F. & Woodward, E.M.S. (2015). Nutrient cycling in the Atlantic basin: The evolution of nitrate isotope signatures in water masses, *Global Biogeochemical Cycles*, 29(10), 1830-1844, doi:10.1002/2015gb005164
- Zheng X., Plancherel Y., Saito, M. A., Scott P. M. & Henderson G. M. (2016) Rare earth elements (REEs) in the tropical South Atlantic and quantitative deconvolution of their non-conservative behavior. *Geochimica et Cosmochimica Acta.* doi:10.1016/j.gca.2016.01.018.

Cruises

- GA08: Pa and Th samples for Gideon Henderson
- GPpr04: Process Study: The supply of iron from shelf sediments to the ocean
- GPpr04 leg 2- DY033 11/7/2015-03/8/2015

New projects and/or funding

- Lohan, M.C & Tagliabue, A. NERC Standard Grant ‘The impact of mid-ocean ridges on the ocean’s iron cycle’
- Mahaffey, C. Tagliabue, A. & Lohan, M.C. NERC Standard Grant ‘ZIPLOc Zinc, iron, phosphorus co-limitation in the Ocean’.
- Plancherel, Y. NERC Independent Research fellowship ‘The large-scale oceanic distribution of trace elements: disentangling performed contributions, regenerative processes, subsurface controls and sinks’.

PhD theses

- Roulin Khondoker, 2015. Anthropogenic vs natural sources of aerosols over the South Atlantic Ocean, Imperial College London, 216 pages
- Luke James Bridgestock, 2015. Tracing the cycling of Pb and Cd from natural and anthropogenic sources through the troposphere and ocean. Imperial College London, 182 pages.
- Torben Struve, 2016. Deciphering glacial-interglacial Southern Ocean dynamics with deep-sea corals. Imperial College London, 196 pages.

Meetings

- Presentations at Royal Society Meeting ‘Quantifying fluxes and processes in trace-metal cycling at ocean boundaries’.

This meeting was organised by UK GEOTRACES and funding secured from Royal Society and GEOTRACES.

UK Presentations:

1. Homoky, W. Discerning the mechanisms and measuring the rates of trace metal release from ocean sediments.
 2. Henderson, G. U-series rate-meters for ocean processes
 3. Little, S. Isotope tracing of boundary fluxes
 4. Jickells, T. Atmospheric transport to the oceans of trace elements and micronutrients.
 5. Van der Flierdt, T. Radiogenic isotope tracers of present and past ocean circulation
- Presentations at Goldschmidt 2015
 - Bridgestock, L., van de Flierdt, T., Rehkämper, M. Baker, A. Achterberg, E. Rijkenberg, M. Lohan, M. de Baar, H. Detection of Pb from natural sources in the Tropical Atlantic
 - Lamblet, M., van de Flierdt, T., Butler, E.C.V., Bowie, S.R., Rintoul, S.R., Watson, R.J., Remenyi, T., Lannuzel, D. The Nd isotopic composition and concentrations in the Australian sector of the Southern Ocean-insights from GIPY6 GEOTRACES cruise along 140oE.
 - Little, S., Vance, D. & Milne, A. Particulate metal stable isotopes in the South Atlantic.

- Ganeshram, R.S. & Tuerena, R.E. Nitrogen cycling in the Atlantic: Insights from Nitrate $\delta^{15}\text{NNO}_3$ & $\delta^{18}\text{ONO}_3$ measurements across the UK-GEOTRACES 40oS transect
 - Henderson, G., Deng, F., Hsieh, Y-T. & Placheral, Y. Quantifying oceanic trace elements with U-Series isotopes
 - Homoky, W.B., Conway, T.M., John, S., Heish, Y.T., Woodward, E.M.S., Henderson, G.M. & Mills, R.A. The iron isotope signature of shallow pore waters spanning the depth of the South Atlantic Ocean.
 - Lohan, M.C., Milne, A., Schlosser, C., Achterberg, E., Chance, R., Baker, A. Particulate iron, an important source of dissolved Fe.
 - Murphy, K., Rehkämper, M. van de Flierdt, T. Abraham, K. Barling, J., Halliday, A.N., Hein, J. Nielsen, S. & Reinhard C.T. Cadmium isotope composition of Cenozoic seawater from ferromanganese crusts.
 - Stichel, T., Kretschmer, S. Lambelet, M. van de Flierdt, T., Rutgers van der Loeff, M., Rijkenberg, M.J.A. Gerringa, L.J. & deBaar H.J.W. The interplay between particulate and dissolved neodymium in the Western North Atlantic
- Presentations at Ocean Science 2016
 - Annett, A., Birchill, A., Lakr, J.K., Homoky, W.B., Lohan, M.C., Statham, P.J. & Thomas, A. Using radium isotopic fingerprinting to quantify iron release and distribution from different Celtic Sea shelf sediment types.
 - Birchill, A., Milne, A., Ussher, S., Annett, A., Giebert, W., Statham, P.J. The Celtic Sea Shelf system acts as persistent source of iron to the North Atlantic.
 - Daniels, C., Lohan, M.C, Poulton, A. & Moore, C.M.M. Iron uptake in a shelf sea: seasonality and stoichiometry.
 - Klar, J., Homoky, W.B., Chever, F., Lichtschlag, A., Graves, C.A., Annett, A. & Statham, P.J. Seasonal variability in sediment porewater Fe and potential for water column release in the Celtic Sea.
 - Lohan, M.C. Birchill, A., Milne, A., Ussher, S. & Worsfold, P.W. Seasonal cycling of dissolved and colloidal iron in the Celtic Sea.
 - Mahaffey, C., Reynolds, Davis, C. & Lohan, M.C. Nutrient and trace metal controls on alkaline phosphatase in the Subtropical Ocean: Insights from bioassay and gene expression
 - Milne, A., Palmer, M. & Lohan, M.C. Key sources and distributions patterns of particulate material in the S. Atlantic data from UK GEOTRACES.
 - Plancherel, Y., Henderson, G.M., Deng, F., Khatiwala, S. and Hsieh, Y.-T. Evaluating the ability of the Thorium-232 and Thorium-2310 isotopic couple to quantify lithogenic fluxes to the Ocean.
 - Sander, S.G., Buck, K.N., Lohan, M.C. Turner, D.R. & Clegg, S.L. Metal speciation analysis and modelling-How do we best estimate the bioavailable form.
 - Stichel, T., Lough, A.J.M., Homoky, W.B., Connelly, D., Klar, J.K & Conway, T.M. Iron isotopes in bottom waters from the Bransfield Strait: Implications for deep water Fe supply.

- Tagliabue, A., Boyd, P., Rijkenberg, M., Williams, R. How do local and remote processes affect the distribution of iron in the Atlantic Ocean?
- Ye, Y., Tagliabue, A., Volker, C. Prognostic modelling of iron-binding ligands in a global biogeochemical models and its effect on iron distribution.
- Woodward, E.M.S. Seasonal trends of nutrients over the 18 month Shelf Sea Biogeochemistry Programme
- Tutorial: Tagliabue, A. What controls the distribution of dissolved iron in the ocean?
- Presentations at EGU 2016
 - Carney, L., Plancherel, Y., Khatiwala, S. and Henderson G.M. (17th-22nd April, 2016). A model-based evaluation of sedimentary reconstructions of ^{10}Be production rates.
- Maeve Lohan attended a Standards and Intercalibration meeting in April 2016
- Alessandro Tagliabue attended a SCOR WG 145 ‘Chemical Speciation in Modelling seawater to meet 21st Century needs (MARCHEMSPEC)’

Outreach activities

- Will Homoky was a NERC ‘Anniversary Ambassador’ on board the *RSS Discovery* outreach event in London (Oct 2015) and spoke to members of public about GEOTRACES research
- Public Evening lecture series ‘Isotopes in the Earth Sciences’, Cardiff University (February 2016). T. van de Flierdt delivered a presentation on ‘Ocean Currents, Ice Sheets and Climate: A story unravelled by radiogenic isotopes’.

Other activities (e.g. acquisition of new sampling systems)

- New Polar Ship (due in 2019) and will include a trace metal clean sampling laboratory, conducting Kevlar winch and trace metal clean CTD.
- Myriam Lambelet won the postdoctoral medal from the Geochemistry Group of the Geological Society for her paper on ‘Neodymium isotopic composition and concentration in the western North Atlantic Ocean: Results from the GEOTRACES GA02 section’. She delivered a keynote talk on the paper at the annual Geochemistry Group Research in Progress meeting (Leeds, March 2016).

National and International service

- The UK continues to host the GEOTRACES Data Assembly Centre at the British Oceanographic Data Centre in National Oceanography Centre Southampton.
- The UK is represented on the International GEOTRACES SSC and on the International Standards and Intercalibration Committee by Maeve Lohan.
- Alessandro Tagliabue is the co-chair of the Data Management Committee.

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