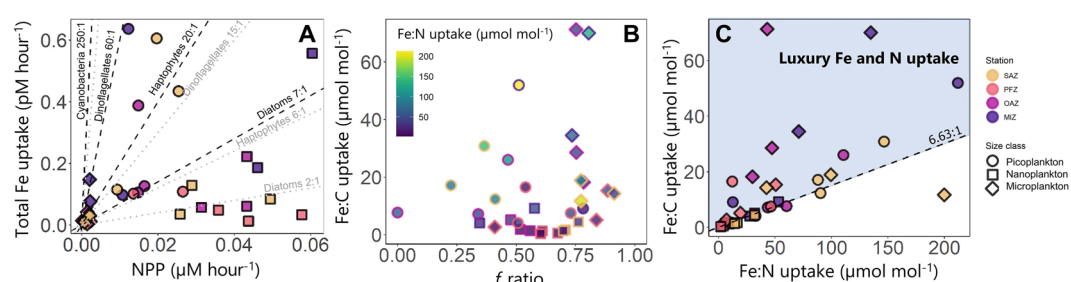


ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SOUTH AFRICA

May 1st, 2023 to April 30th, 2024

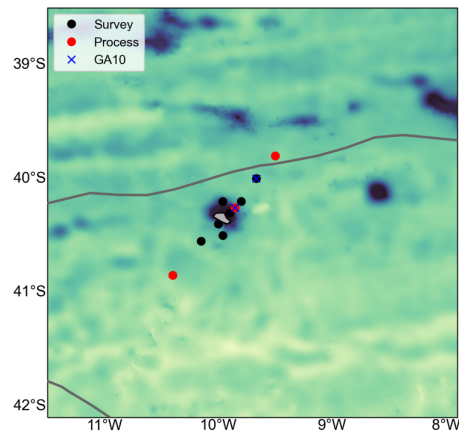
New GEOTRACES or GEOTRACES relevant scientific results

- Flynn et al. 2024 <https://www.science.org/doi/10.1126/sciadv.adi3059>: Size fractionated uptake rates of carbon, nitrogen and iron in the Atlantic sector of the Southern Ocean. This unique dataset from spring 2019 as part of the SCALE program provide the opportunity to determine the iron requirements of different phytoplankton, including which groups preferentially take up inorganic vs organically bound iron. The low iron requirements of the diatom *Chaetoceros* sp. allowed it to dominate biomass, primary production and nitrate uptake across this basin, where it was estimated to account for 25% of the annual export production.



GEOTRACES or GEOTRACES relevant cruises

- Oceanographic cruise to Gough Island, 14/09/2023 – 17/10/2023, on board the RV SA Agulhas II. South African team members on board: Dr Thato Mtshali (DFFE), Dr Ole Valk (Stellenbosch University), PhD candidate Thapelo Ramalepe (Stellenbosch University) and MSc candidate Miranda Sitofile (Stellenbosch University). The team sampled 10 stations around the island for samples, including dissolved, particulate, ligands and DOM.



New projects and/or funding

- Dr T. Ryan-Keogh, CSIR, National Research Foundation of South Africa (NRF; 2024-2027): “ECOSOPHY: Emergent constraints on Southern Ocean Phytoplankton physiology”
- Prof. S Fietz, Stellenbosch University, National Research Foundation of South Africa (NRF; 2024-2027): “Micronutrient and pollutant trace elements at the air-sea interface of the Southern Ocean”
- Prof. S. Fietz, Stellenbosch University, CPRR of South Africa (2023-2026): “Metals in southern African aerosols and their potentially toxic impact on marine phytoplankton”
- A. Prof. S Fawcett, University of Cape Town, ERC Synergy Grant (2024-2030): “WHIRLS: The impact of ocean fine-scale whirls on climate and ecosystems”
- A. Prof. S. Fawcett, University of Cape Town, Schmidt Sciences Ocean Biogeochemistry Virtual Institute Grant (2024-2029): “Oxygen and biogeochemical dynamics along the west African margin: Processes and consequences”

Outreach activities conducted (please list any outreach/educational material available that could be shared through the GEOTRACES web site) (We are particularly interested in recordings from webinars from GEOTRACES research)

- Newspaper interview: Climatologists outline their agenda for Africa in 2023. University World News, Africa edition, Jan 2023
- Radio interview: Radio 786, “Pollution and oxygen levels in our oceans”, November 2023
- School engagement: The Antarctic Year, at Ukhanyo Primary, Cape Town, June 2024

Other GEOTRACES activities

- None

New GEOTRACES or GEOTRACES-relevant publications (published or in press) (If possible, please identify those publications acknowledging SCOR funding)

South African based authors in bold.

South African led publications:

- **Demasy C., Singh A., Samanta S., Ryan-Keogh T.J., Roychoudhury A.N** (2024 *Submitted*) Toxic impact of aluminium on the natural phytoplankton community during spring in the Southern Ocean. *Science of The Total Environment*
- **Ramalepe, T., Samanta, S., Cloete, R., Ryan-Keogh, T.J., Roychoudhury, A.N.** (2024 *In revision*) Winter physical supply of dissolved manganese for springtime biological consumption in the Southern Atlantic Ocean. *Limnology and Oceanography*
- **Flynn, E.F.,** Haraguchi, L., McQuaid, J., **Burger, J.M., Lunga, P.M., Stirnimann, L., Samanta, S., Roychoudhury, A.N., and Fawcett, S.E.** (2023) Nanoplankton: the dominant vector for carbon export across the springtime Southern Ocean. *Science Advances*, V9(48), 1-17, doi: 10.1126/sciadv.adi3059
- **Singh, A., Fietz, S., Thomalla, S.J.,** Sanchez, N., Ardelan, M.V., Moreau, S., Kauko, H.M., Fransson, A., Chierici, M., **Samanta, S., Mtshali, T.N., Roychoudhury, A.N. and Ryan-Keogh, T.J.** (2023) Absence of photophysiological response to iron addition in autumn phytoplankton in the Antarctic sea-ice zone. *Biogeosciences*, V20, 3073–3091, doi: 10.5194/bg-20-3073-2023
- **Stirnimann, L., Bornman, T.G., Forrer, H.J., Mirkin, J., Flynn, R.F., Ryan-Keogh, T.J., Dorrington, R.A., Verheye, H.M., Fawcett, S.E.** A circum-Antarctic plankton isoscape: Carbon export potential across the summertime Southern Ocean. *Global Biogeochemical Cycles* 38, 10.1029/2023GB007808 (2024).
- **Marshall, T.A.,** Beal, L.M., Sigman, D.M., **Fawcett, S.E.** Instabilities across the Agulhas Current enhance upward nitrate supply in the southwest subtropical Indian Ocean. *AGU Advances* 4, 10.1029/2023AV000973 (2023).
Editors' highlight in Eos (<https://eos.org/editor-highlights/how-nutrients-get-back-up-to-the-surface-ocean>)

Publications with South African contribution:

- Deteix, V., Cotard, E., Caquineau, S., Landing, W.M., Planchon., F., **Ryan-Keogh, T.J.,** Cardinal, D., (2024), Biogenic and lithogenic silicon along the GEOTRACES South West Indian Ocean section (SWINGS-GS02) and the islands mass effect on regional Si biogeochemical cycle, *Marine Chemistry*, doi: 10.1016/j.marchem.2024.104412
- J. Duan, R. Cloete, **J. C. Loock,** A. Lanzirotti, M. Newville, A. Martinez-Garcia, D. M. Sigman, P. J. Lam, **A. N. Roychoudhury,** S. C.B. Myneni (2024) Biogenic-to-Lithogenic Handoff of Particulate Zinc Controls the Zn-Cycle in the Southern Ocean. *Science* V384, 1235-1240, doi: 10.1126/science.adh8199
- Buck, C.S., **S. Fietz,** D.S. Hamilton, T.-Y. Ho, M.M.G. Perron, and R.U. Shelley. 2024. GEOTRACES: Fifteen years of progress in marine aerosol research. *Oceanography* 37(2):116–119, <https://doi.org/10.5670/oceanog.2024.409>.
- Perron, M. M. G., **Fietz, S.,** Hamilton, D. S., Ito, A., Shelley, R. U., & Tang, M. (2024). Preface to the inter-journal special issue “RUSTED: Reducing Uncertainty in Soluble aerosol Trace Element Deposition”, *Atmospheric Measurement Techniques* 17, 165–166, <https://doi.org/10.5194/amt-17-165-2024>.

- Shalileh, F, Gheibzadeh, MS, Lloyd, JR, **Fietz, S**, Shahbani Zahiri, H, Zolfaghari Enameh, R. Evolutionary analysis and quality assessment of ζ -carbonic anhydrase sequences from environmental microbiome. *J Basic Microbiol.* 2023; 1–14. <https://doi.org/10.1002/jobm.202300323>
- Vos, H.C., Kangueehi, K.I., ... **Fietz S**. Spatial variability of dust concentration and deposition around an industrial port in South Africa emphasises the complexity of sources and transport. *Air Qual Atmos Health* (2024). <https://doi.org/10.1007/s11869-024-01581-8>
- Casciotti, K.L., **Marshall, T.A., Fawcett, S.E.**, Knapp, A.N. Advances in understanding the marine nitrogen cycle in the GEOTRACES era. *Oceanography* 10.5670/oceanog.2024.406 (2024).
- Lachkar, Z., Cornejo-D’Ottone, M., Singh, A., Aristegui, J., Dewitte, B., **Fawcett, S.E.**, Garçon, V., Lovecchio, E., Molina, V., Vinayachandran, P.N.M. Biogeochemistry of greenhouse gases in coastal upwelling systems: Processes and sensitivity to global change. *Elementa Science of the Anthropocene* 12, 10.1525/elementa.2023.00088 (2024).

Please indicate if there is any forthcoming or planned GEOTRACES special issue publication

- None

Completed GEOTRACES PhD or Master theses (please include the URL link to the pdf file of the thesis, if available)

- Lide Jansen van Vuuren, MSc, “Dynamics of dissolved iron in the marginal ice zone in the South Atlantic and Southern Ocean”, Stellenbosch University
- Liam Quinlan, MSc, "Characterising Southern Ocean Phytoplankton Community Variability and Environmental Coupling: Zonal, Sectoral, and Seasonal Perspectives", Stellenbosch University, <https://scholar.sun.ac.za/items/90c0592b-f381-4f03-ad88-3ae7a774ec27>
- Tanya Marshall, PhD, “Nitrogen cycling in the South Atlantic and South Indian Oceans investigated using nitrate isotopes: implications for nutrient supply, ocean fertility, carbon export and climate”, University of Cape Town, <https://open.uct.ac.za/items/505ed141-c1c8-4f27-94f2-81f18091704d>
- Luca Stirnimann, PhD, “Plankton dynamics of the open Southern Ocean and surrounding the (Sub)Antarctic islands”, University of Cape Town, <https://open.uct.ac.za/items/8eaeb7e2-a92e-4415-84e2-07b2c5d55e50>
- Joshua Mirkin, MSc, “Nitrogen cycle-based estimates of carbon export potential in the waters adjacent to Larsen C Ice Shelf in the western Weddell Sea, Antarctica”, University of Cape Town, <https://open.uct.ac.za/items/2fc6d193-c750-48ac-8eb7-8f474674a5d2>

GEOTRACES presentations in international conferences

South African based authors in bold.

- **Saumik Samanta** and **Alakendra Roychoudhury** (2024) Don't save the whales, so says the iron biogeochemistry. Goldschmidt Conference, Chicago, USA, 18 – 23 August.
- **Alakendra Roychoudhury, Kayla Buchanan, Saumik Samanta** (2024) Marginal sea-ice is not a major source of iron to support spring blooms in the South Atlantic. EGU general assembly, Vienna, Austria, 14 – 19 April.
- **Saumik Samanta, Kayla Buchanan, Alakendra N Roychoudhury** (2023) Is marginal sea ice a source of Fe and impacts productivity in South Atlantic? SOOS Symposium, Hobart, Australia, 14 – 18 August.
- **Saumik Samanta, Ryan Cloete, Lide Jansen van Vuuren, Alakendra N Roychoudhury** (2023) Seasonal cycling of Fe in the marginal ice zone of Southern Ocean around zero meridian: linkage to phytoplankton bloom. SOOS Symposium, Hobart, Australia, 14 – 18 August.
- R. Cloete, **S. Samanta, Nadine Ellis, Lide Jansen van Vuuren**, Corentin Baudet, Pierrick Penven, Steven Herbette, **Alakendra Roychoudhury**, Eva Bucciarelli and Helene Planquette (2023) Iron and mesoscale eddy dynamics in the South West Indian Ocean. Goldschmidt Conference, Lyon, France, 9 – 14 July.
- Satish Myneni, Jianshu Duan, Ryan Cloete, Daniel M. Sigman, Phoebe J. Lam, Antonio Lanzirotti, Matthew Newville, Alfredo Martinez-Garcia and **Alakendra Roychoudhury** (2023) Speciation of Particulate Zn in the Southern Ocean: Implications for Zn-cycling. Goldschmidt Conference, Lyon, France, 9 – 14 July.
- A. Ringard, H. Planquette, Eva Bucciarelli, R. Cloete, **A.N. Roychoudhury** (2023) Spatial and temporal variability of particulate iron and manganese in the Atlantic sector of the Southern Ocean: spring vs winter. Goldschmidt Conference, Lyon, France, 9 – 14 July.
- **Lide Jansen van Vuuren, Saumik Samanta, Ryan Cloete, Alakendra N Roychoudhury** (2023) Seasonal cycling of dissolved Fe in the South Atlantic marginal ice zone of the Southern Ocean. Goldschmidt Conference, Lyon, France, 9 – 14 July.
- **Saumik Samanta, Lide Jansen van Vuuren, Ryan Cloete, Alakendra N Roychoudhury** (2023) Dissolved iron dynamics in the marginal ice zone and spring blooms. ASLO Aquatic Sciences Meeting, Palma De Mallorca, Spain, 4 – 9 June.
- **S Fietz, K Kanguuehi, S Samanta, AN Roychoudhury**, F Eckardt (2023) Trace metal concentrations and solubility in aerosols over the oceans south of South Africa. ASLO Aquatic Sciences Meeting, Palma De Mallorca, Spain, 4 – 9 June.
- **Marshall, T.A.**, Sigman, D.M., Beal, L.M., Granger, R., Foreman, A., Martínez-García, A., Auderset, A., Blain, S., Campbell, E.C., Fripiat, F., Harris, E., Haugh, G., Marconi, D., Oleynik, S., Rafter, P.A., Roman, R., **Sinyanya, K.Y.**, Smart, S.M., **Fawcett, S.E.** “Nitrogen cycling in the Agulhas Current I: Local and remote signals of Indian Ocean processes,” Ocean Sciences Meeting, 2024.
- Ryu, Y., Marconi, D., Luu, V.H., Smart, S.M., **Fawcett, S.E.**, Run, Z., Johnson, R.J., Knapp, A.N., Ward, B.B., Sigman, D.M. “Isotopic evidence for two sources of dissolved organic nitrogen in the deep ocean,” Ocean Sciences Meeting, 2024.
- **Flynn, R.F., Bornman, T.G., Mirkin, J., Smith, S., Altieri, K.**, Granger, J., **Fawcett, S.E.** “Phytoplankton group-specific contributions to new production in the summertime Weddell Sea,” Ocean Sciences Meeting, 2024.

- **Fawcett, S.E., Marshall, T.A., Sinyanya, K.Y., Flynn, R.F., Forrer, H.J.,** Ryu, Y., Walker, D.R., Sigman, D.M., Beal, L.M. “Nitrogen cycling in the Agulhas Current II: Agulhas Current dynamics drive (sub)mesoscale nitrate fluxes that fuel new production,” Ocean Sciences Meeting, 2024.
- **Wallschuss, S.,** Bourbonnais, A., Granger, J., **Flynn, R.F., Burger, J.,** Pillay, K., **Fawcett, S.E.** “Mechanisms of nitrous oxide (N₂O) production in the southern Benguela upwelling system: insights from isotopic tracers,” Ocean Sciences Meeting, 2024.
- **Stirnemann, L., Bornman, T.G., Verheye, H.M.,** Michel, L.N., Puccinelli, E., **Forrer, H.J., Mirkin, J., Ryan-Keogh, T.J., Flynn, R.F., Dorrington, R.,** Suaria, G., **Fawcett, S.E.** “Using a circum-Antarctic plankton isoscape to assess carbon export potential and plankton trophic structure across the Southern Ocean,” Ocean Sciences Meeting, 2024.
- Thomas, R.K., **Fawcett, S.E.,** Kranz, S.A., Chappell, P.D., Einarsson, S., **Forrer, H.J.,** Graves, E., Haraguchi, L., Robinson, C.M., **Roychoudhury, A.N., Ryan-Keogh, T.,** Knapp, A.N. “Evaluating the role of light and iron on nitrate assimilation isotope effect estimates in the Southern Ocean,” Aquatic Sciences Meeting 2023.
- Marshall, T.A., Sigman, D.M., Beal, L.M., Foreman, A., Martínez-García, A., Blain, S., Campbell, E., Fripiat, F., Granger, R., Harris, E., Haug, G.H., Marconi, D.M., Oleynik, S., Rafter, P.A., Roman, R., **Sinyanya, K., Smart, S.M., Fawcett, S.E.** “Nutrient fluxes in the greater Agulhas Current region: signals of local and remote Indian Ocean nitrogen cycling,” EGU General Assembly, 2023.

Submitted by **Tommy Ryan-Keogh (tryankeogh@csir.co.za)**