ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SOUTH AFRICA

May 1st, 2024 to April 30th, 2025

New GEOTRACES or GEOTRACES relevant scientific results

Cloete et al. (2024), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2024JC021542.

Winter dissolved nickel (dNi) and particulate nickel (pNi) concentrations were measured in the Southern Ocean (GEOTRACES GIpr07 transect) to investigate biogeochemical cycling within the water column and over seasonal timescales. Concentrations of dNi ranged from 1.98 to 8.21 nmol kg−1 with low surface concentrations and maxima in deepest sampled water masses. Combining our winter data with the GEOTRACES Intermediate Data Product (2021) shows insignificant seasonal dNi variation in surface waters north of the Antarctic Polar Front, indicating the dominance of year-round mixing processes. However, lower summer concentrations than winter in the Antarctic Zone (Δ0.23 nmol kg−1) suggest a role for biological processes at high latitudes. For pNi, concentrations ranged from 5 to 49 pmol kg−1 with higher values in surface/near-surface water masses. Vertical attenuation factors (*b* values) for pNi (0.19 ± 0.06) and particulate phosphorus (pP; 0.43 ± 0.10) suggest a greater retention of Ni in particles than P, invoking scavenging processes or refractory Ni phases. Water mass analysis shows that remineralization of pNi contributes a maximum of 6% of the highest measured dNi. Instead, dNi distributions and macronutrient relationships were largely explained by phytoplankton uptake in surface waters, and mixing and advection of Atlantic and Antarctic origin water masses, each with different preformed nutrient compositions. Winter trace metal measurements provide new perspectives regarding the balance between biological and physical drivers in the Southern Ocean. For Ni, the biological component is small with respect to physical mixing processes and over the timescales in which water masses accumulate Ni during their transport.

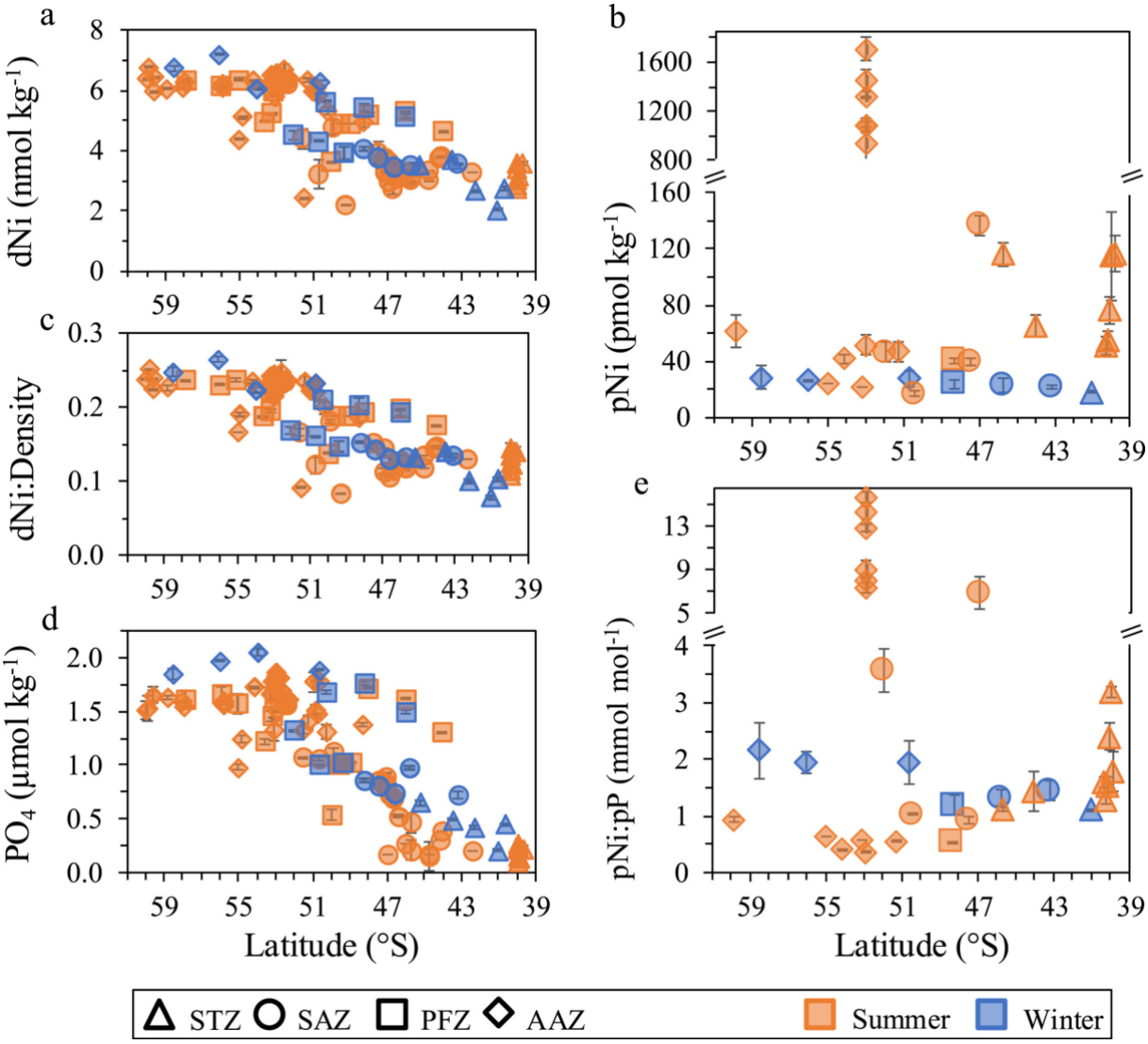

Figure 3: Distribution plots of (a) dNi, (b) pNi, (c) ratios of dNi to seawater density, (d) PO4, and (e) ratios of pNi to pP, for a compilation of winter (blue) and summer (orange) measurements from the Southern Ocean (see Section 2.5 and Figure S4 in Supporting Information S1 for data compilation details). For a, c, and d, values represent median ±sd from the surface mixed layer. For b and e, values represent median ±sd from the depth range corresponding to 100 ± 30% Chlmax.

GEOTRACES or GEOTRACES relevant cruises

- Oceanographic cruise to Gough Island, Gough 2024, 5 September to 7 October 2024, on board the RV SA Agulhas II. South African team members on board: Dr Thato Mtshali (DFFE), Dr Ole Valk (Stellenbosch University), Dr Clement Demasy (Stellenbosch University), MSc Candidate Miss Miranda Sitofile (SOCCO/Stellenbosch University). The team sampled 10 stations around the island for samples, including dissolved and particulate trace metals. Incubation experiments were performed to look at the island mass effect. This cruise represents the second survey of Gough Island. This cruise was approved as a GEOTRACES process study cruise.
- Oceanographic cruise to Antarctica, SANAE64, 13 December 2024 to 17 February 2025, on board the RV SA Agulhas II. South African team members on board: Dr Ole Valk (Stellenbosch University), Dr Heleen Vos (Stellenbosch University), PhD

Candidate Miss Nosipho Hlalukana (Stellenbosch University), MSc Candidate Miss Miranda Sitofile (SOCCO/Stellenbosch University), MSc Candidate Miss Lillina Ruiters (SOCCO/University of Cape Town), MSc Candidate Miss Nina Woithe (Stellenbosch University), MSc Candidate Miss Alice Edwards (Stellenbosch University), MSc Candidate Miss Skyla Thornton (Stellenbosch University) and BSc Hons Mr Hugo Johnson (Stellenbosch University). The team sampled 16 stations in open water and in sea ice close to the continental shelf for samples, including dissolved and particulate trace metals. Incubation experiments were performed to look at impacts of Fe limitation, Mn limitation, light limitation and warming. This cruise was approved as a GEOTRACES process study cruise.

New projects and/or funding

None

GEOTRACES workshops and meetings organised

- GEOTRACES Summer School organised to run from 17 - 21 November 2025.

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)*

- Susanne: Active social media accounts, including SU's Geotraces relevant activities: **@suearthsciences** (Linkedin, Instagram, Facebook, Tiktok)
- Susanne with Rabia (SAPRI): School intervention at Ukhanyo Primary, a 'The Antarctic Year Engagement event' (06/2024) (Presentation and activity on 'Tiny organisms and elements in the ocean')
- Susanne: Primary School learners intervention: Identifying how robots can overcome logistical sampling issues at sea to help students prep. for local science & robotics competition (09/2024)

Other GEOTRACES activities

None

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

All South African based authors in bold.

South-African led publications:

- **Cloete, R.**, Planquette, H., **van Horsten, N.R.**, **Samanta, S.**, Chen, X-G., Achterberg, E.P., Middag, R., Jannsen, D.J., Bowie, A.R., van der Merwe, P., **Loock, J.C., Mtshali, T.N., Fietz, S., Roychoudhury, A.**, (2024), Drivers of nickel distribution and seasonality in the Southern Ocean: New perspectives from the GEOTRACES GIpr07 transect. *JGR Oceans*, doi: 10.1029/2024JC021542.

- **Sinyanya, K.Y., Marshall, T.A., Flynn, R.A., Harris, E., Mdutyana, M., Roman, R., Walker, D.R., Wallschuss, S., Fawcett, S.E.**, (2024), Wintertime productivity and carbon export potential across the Agulhas Current system. *Deep-Sea Research Part I: Oceanographic Research Papers*, doi: 10.1016/j.dsr.2024.104405.
- **Stirnimann, L., Bornman, T.G., Verheye, H.M., Fawcett, S.E.**, (2024), Seasonal trends in Subantarctic plankton δ13C and δ15N are driven by phytoplankton dynamics and nutrient preference. *Limnology and Oceanography*, doi: 10.1002/lno.12685.
- **Granger, R.**, Smart, S.M., Foreman, A., Auderset, A., Campbell, E.C., **Marshall, T.A.**, Haug, G.H., Sigman, D.M., Martinez-Garcia, A., **Fawcett, S.E.**, (2024), Tracking Agulhas leakage in the South Atlantic using modern planktic Foraminifera nitrogen isotopes. *Geochemistry, Geophysics, Geosystems*, doi: 10.1029/2023/GC011190.
- Preprint: **Johannes J Viljoen, Ryan Cloete, Raïssa Philibert, et al.** Winter dynamics of phytoplankton and micronutrients in the Southern Ocean. *ESS Open Archive* . February 06, 2025. https://doi.org/10.22541/essoar.173884384.49518335/v1
- **Belelie, M.D.**, Burger, R.P., von Holdt, J.R.C., Garland, R.M., Liswaniso, G.M., **Thomalla, S.J.**, Piketh, S.J., (2025), Namib desert dust affects phytoplankton biomass in the Benguela upwelling region: Insights from first mesocosm study. *Continental Shelf Research*, doi: 10.1016/j.csr.2024.105400.

Publications with South African contribution:

- Hassler, C.S., Simo, R., **Fawcett, S.E.**, Ellwood, M.J., Jaccard, S.L., (2025), Marine biogenic humic substances control iron biogeochemistry across the Southern Ocean. *Nature Communications*, doi: 10.1038/s41467-025-57491-5.
- Thomas, R.K., **Fawcett, S.E., Forrer, H.J.**, Robinson, C.M., Knapp, A.N., (2024), Estimates of the Isotope Effect for Nitrate Assimilation in the Indian Sector of the Southern Ocean. *Journal of Geophysical Research: Oceans*, doi: 10.1029/2023JC020830.
- Carlson, A.J., Siedlecki, S.A., Granger, J., Veitch, J., Pitcher, G.C., Fearon, G., Soares, F., Zhou, M., Flynn, R.F., **Fawcett, S.E.**, (2025), Seasonal source water changes and winds contribute to the development of hypoxia in St Helena Bay with the southern Benguella upwelling system. *Journal of Geophysical Research: Oceans*, doi: 10.1029/2024JC021702.
- Buck CS, **Fietz S**, Hamilton DS, Ho T-Y, Perron MMG, Shelley RU (2024). GEOTRACES: Fifteen years of progress in marine aerosol research. Oceanography 37(2):116–119, https://doi.org/10.5670/oceanog.2024.409
- Perron MMG, **Fietz S**, Hamilton DS, Ito A, Shelley RU, 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.

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)*

- Miranda Sitofile, MSc, “The seasonal iron supply in the Southern Ocean”, Stellenbosch University.
- Sadiyah Rawat, MSc, “The island mass effect shapes the top-down and bottom-up controls on productivity and export in the Indian Southern Ocean”, University of Cape Town.
- Kereemang Gaoaaga, MSc, “Geochemical composition of dust particles in informal residential settlements in the Western Cape, South Africa”, Stellenbosch University.

GEOTRACES presentations in international conferences

All South African based authors in bold.

- **Alakendra Roychoudhury & Saumik Samanta**, 2024, Don’t save the whales, so says the iron biogeochemistry. Goldschmidt, Chicago, USA, 18-23 August.
- **Thapelo Ramalepe, Alakendra Roychoudhury & Tommy Ryan-Keogh**, 2025, Iron and manganese fluxes in the Southern Ocean. ASLO Aquatic Sciences Meeting, Charlotte, USA, 26-31 March.
- **Tommy Ryan-Keogh** & Alessandro Tagliabue, 2025, How can we effectively manage the impacts of climate change on Antarctic ecosystems? ICSHMO, Cape Town, South Africa, 31 March - 4 April.
- **Thapelo Ramalepe, Alakendra Roychoudhury & Tommy Ryan-Keogh**, 2025, Deep winter mixing drives the mixed layer supply of iron and manganese in the Southern Ocean. ICSHMO, Cape Town, South Africa, 31 March - 4 April.
- **Miranda Sitofile, Tommy Ryan-Keogh & Alakendra Roychoudhury**, 2025, The seasonal cycle of iron supply in the Southern Ocean. ICSHMO, Cape Town, South Africa, 31 March - 4 April.
- **Susanne Fietz** S. Solubility of trace metals in the atmosphere: overview and laboratory experiments. The Surface Ocean–Lower Atmosphere Study (SOLAS) Open Science Conference, Goa, India, 11/2025, SCOR-RUSTED Workshop
- **Susanne Fietz**, **Lynwill Martin**, Lars-Eric Heimbuerger-Boavida. Knowledge and technology transfer to investigate marine mercury contamination in SA. International Conference On Mercury as a Global Pollutant (ICMGP 2024), Cape Town, 07/2024
- **Emtia Wium**, **Susanne Fietz**. Effect of dust loads and metal content on marine phytoplankton growth: South African perspective. The Surface Ocean–Lower Atmosphere Study (SOLAS) Open Science Conference, Goa, India, 11/2025
- **Liam Quinlan, Susanne Fietz**. Phytoplankton dynamics in the Southern Ocean. International Symposium on Microbial Ecology (ISME), Cape Town, 08/2024
- **Victor Mugabe**, Helene Angot, **Casper Labuschagne**, **Lynwill Martin, Susanne Fietz**. Mercury over the Southern Ocean. International Conference On Mercury as a Global Pollutant (ICMGP 2024), Cape Town, 07/2024

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