## *New scientific results*

- MSc students Johan Viljoen and Ian Weir from the Stellenbosch TracEx team probed the interplay of nutrients (macro- and trace) and phytoplankton community compositions in surface waters of the Bonus Good Hope Line (Atlantic sector of the Southern Ocean). They found that there is no single, definite driving factor, including silicic acid or iron that defines communities across the water masses. Instead they concluded on a highly complex nature of interactions.

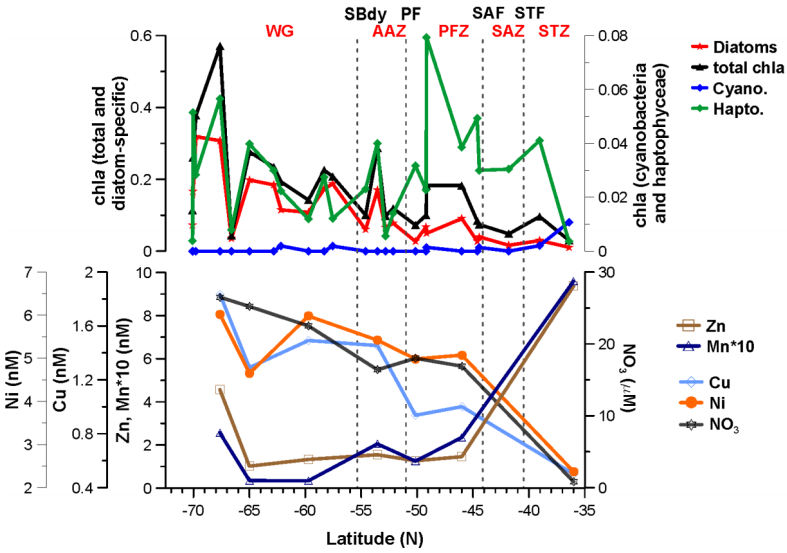


***Figure 15.*** *Total chla and selected phytoplankton group-specific chla (upper panel) versus selected trace and macronutrients (lower panel) illustrating the complex interplay of driving factors for phytoplankton community structure (Viljoen et al., in review)*

- PhD students Ryan Cloete and Jean Loock completed the trace metal measurements from the first Winter Cruise into the Indian sector of the Southern Ocean and linked those to water mass distribution as well as biological processes. For example, first measurements of cadmium (Cd) and zinc (Zn) from the 30°E line allowed them to investigate the biological, geographical and chemical factors controlling the distribution of these important micronutrients. Cd and Zn are geochemically alike yet display different behaviours in the ocean and therefore we aimed to identify the drivers of this phenomenon. We found biological processes to dominate Zn cycling while Cd cycling was driven by water mass characteristics, factors which likely underpin their divergent behaviour in marine environments. Understanding these complexities are particularly important in the Southern Ocean given that waters of Antarctic origin set the biogeochemical signature of the low latitude oceans.

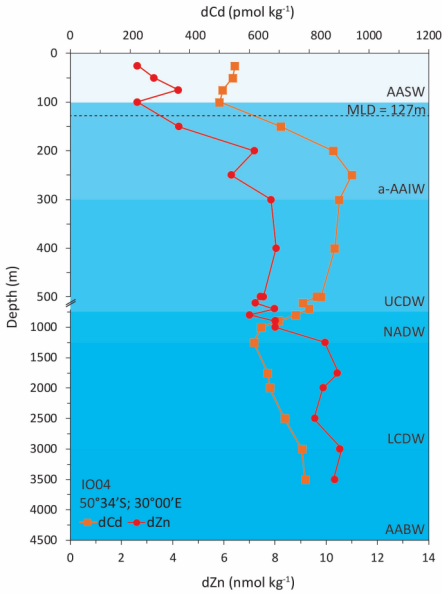


***Figure 16****. First measurements of trace nutrients dZn and dCd in the Indian sector of the Southern Ocean at 50°S, 30°E (Cloete et al, in prep.)*

- PhD student Jean Loock and the TracEx team further initiated internal development and testing for the protocols required for the collection of uncontaminated trace metals in ice cores from seasonal sea-ice (pancake ice). It is probable that trace metal fluxes from melting sea ice may be enhancing or sustaining photosynthetic micro-organism (phytoplankton) productivity in remote seasonally ice-covered regions. Hence melting sea-ice may play a significant role in $CO_2$ uptake within the

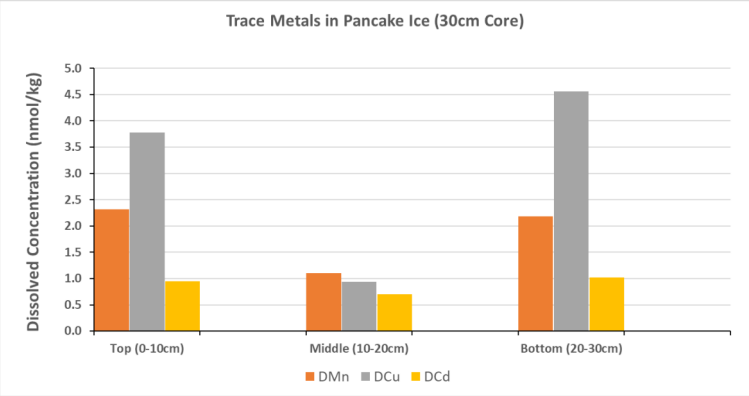


***Figure 17****. Trace metal concentrations in different sections (downcore) of a pancake retrieved from the Indian sector of the Southern Ocean in winter 2017.*

Southern Ocean and quantifying the metal flux is imperative to constraining sea-ice as source of trace metals. The team collected ice cores using the Kovacs Mark II corer during the Winter Cruise in 2017. The cores were segmented into three parts (± 10cm) and melted within the on-board clean lab using two techniques 1) Direct Melting 2) Seawater addition melting. Sub sample fractions were collected for the total, 0.45µm and 0.2µm. In 2018, we compared the results and found that concentration ranges are within the range of a previously analyzed sea ice core by Grotti *et al*., 2005. These preliminary results suggest that sea-ice contains a potentially significant pool of trace metals which under melting may promote early spring-time phytoplankton growth at high latitudes. A new study has now been initiated in collaboration with UCT-Engineering on probing trace metal evolution in artificially growing ice.

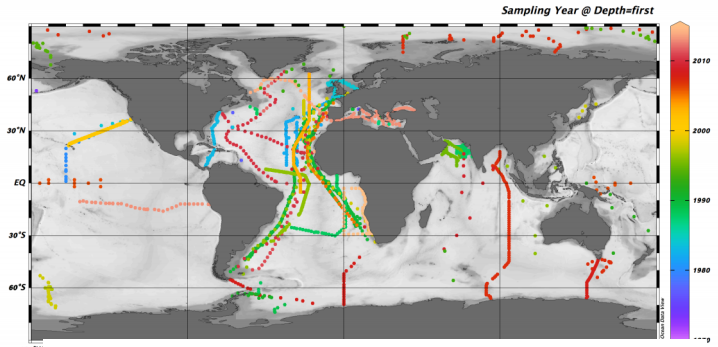


***Figure 18****. Map with the positioning of all the Al data. The colors refer to the sampling year of each station.*

- Dr Jan Lukas Menzel compiled a global oceanic aluminium (Al) database containing historical and recent oceanic observational data. We aim to provide the marine scientist community with the first global compilation of Al observational data.

## *Cruises*

- Tommy Ryan-Keogh (CSIR) and Asmita Singh (Stellenbosch University/CSIR) participated in the Norwegian Dronning Maud Land Cruise (#DronningMaudLandCruise2019) on RV Kronprins Haakon from 26th February to 16th of April 2019. They sampled surface waters using a new towfish and deep waters using GoFlo-CTD for trace metal and protein analysis. They also conducted iron addition experiments testing the short-term photophysiological acclimation of sea-ice related phytoplankton communities.

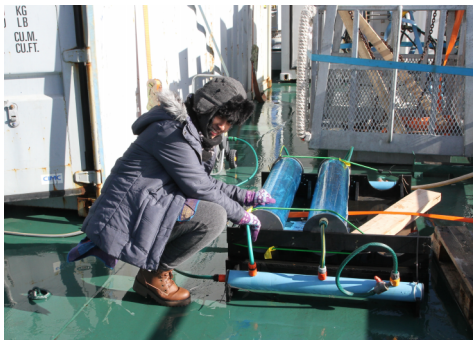

***Figure 19.*** *Asmita Singh preparing the on-deck iron addition incubation experiments.*

***New projects and/or funding***

- Mackey B, Roychoudhury AN, Vichi M, Findlay, K (2019 – 2022) Humpback whales in changing climate, Donor funding AUD 4,019,503.

*Ongoing projects and/or funding*

- Fietz S (2018-2020) South African National Antarctic Programme (SNA170506229934) Shifts in phytoplankton and microbial community composition and functional diversity related to trace metal cycling; R914,000.
- Fietz S, Lloyd J (2018-2020) South African bilateral programme, SA-Iran (IRSA170718254901) Carbonic anhydrases from marine microbes and phytoplankton for enzymatic remediation of cadmium-contaminated water resources; R242,950.
- Fietz S, Lloyd J, Makhalanyane T (2018-2020) South African bilateral programme, SA-Mexico (MESA170607237905) Exploiting microbes for remediation of pollution in oceans; R2,284,200.
- Roychoudhury AN (2017-2019) Nanoparticles at Air-Sea interface. NRF Competitive Rated Researcher Grant, R1,550,000.
- Roychoudhury AN (2017-2019) TraceEx: Establishment of Center of excellence in Trace and experimental Biogeochemistry, Donor funding, R 17 Million.
- Roychoudhury AN (2018-2020) Distribution and Speciation of Bioactive Trace Elements in Southern Ocean, NRF SANAP, R1,820,000.
- Ryan-Keogh T, Mtshali T (2018-2020) Seasonal evolution of biogeochemical Fe cycle in the Southern Ocean. NRF SANAP.

***Outreach activities conducted***

- Stellenbosch TracEx Team blog: https://southernoceanfe.wordpress.com/
- Stellenbosch TracEx Team's facebook page: https://www.facebook.com/Environmental-Geochemistry-at-Stellenbosch-University-135430226505633/
- Stellenbosch TracEx https://twitter.com/TracexS

***New GEOTRACES publications (published or in press)***

*Main publications by SA researchers:*

- Cloete R et al. (2019). Winter and summer distributions of Copper, Zinc and Nickel along the International GEOTRACES section GIPY05: Insights into deep winter mixing. Chemical Geology 511, 342-357. https://doi.org/10.1016/j.chemgeo.2018.10.023
- Fawcett SE et al. (2018) Low-nutrient organic matter in the Sargasso Sea thermocline: A hypothesis for its role, identity, and carbon cycle implications. Marine Chemistry 207: 108-123. https://doi.org/10.1016/j.marchem.2018.10.008
- Menzel Barraqueta J-L et al. (2019) Atmospheric aerosol deposition fluxes over the Atlantic Ocean: A GEOTRACES case study. Biogeosciences, https://doi.org/10.5194/bg-2018-209, accepted
- Ryan-Keogh TJ et al. (2018) Seasonal development of iron limitation in the sub-Antarctic zone. Biogeosciences 15:4647-4660. DOI:10.5194/bg-15-4647-2018
- Viljoen JJ et al. (2018) Response of phytoplankton in growth, community structure and photophysiology to iron and light addition in the Polar Frontal and Antarctic Waters of the

Southern Ocean. Deep Sea research I, 141, 118-129 https://www.sciencedirect.com/science/article/pii/S0967063718301420

- von der Heyden B et al. (2018) Geochemistry of Al and Fe in freshwater and coastal water colloids from the west coast of Southern Africa. Geochimica et Cosmochimica Acta 15:56-68; DOI:10.1016/j.gca.2018.08.043

*Co-authored by SA researchers:*

- Fripiat F et al., incl. Fawcett SE (2019) The isotope effect of nitrate assimilation in the Antarctic Zone: Improved estimates and paleoceanographic implications. Geochimica et Cosmochimica Acta 247: 261-279. https://doi.org/10.1016/j.gca.2018.12.003
- Gourain A et al., incl. Menzel Barraqueta J-L (2018) Inputs and processes affecting the distribution of particulate iron in the North Atlantic along the GEOVIDE (GEOTRACES GA01) section, Biogeosciences, https://doi.org/10.5194/bg-2018-234, accepted, 2019
- Grand MM et al., incl. Fietz S (2019) Developing autonomous observing systems for micronutrient trace metals. Frontiers in Marine Sciences 6:35. https://doi.org/10.3389/fmars.2019.00035
- Sarthou G et al., incl. Menzel Barraqueta J-L (2018) Introduction to the French GEOTRACES North Atlantic Transect (GA01) GEOVIDE cruise. Biogeosciences, 15, 7097-7109, https://doi.org/10.5194/bg-15-7097-2018.

***Completed GEOTRACES PhD or Master theses***

- Viljoen, Johannes Jacobus (Stellenbosch University, 2018-12), CHEMTAX determination of Southern Ocean phytoplankton distribution and adaption: An observational and experimental study assessing the co-limitation of Light, Iron and other Trace Metals on phytoplankton productivity and community composition; http://scholar.sun.ac.za/handle/10019.1/104834
- Weir, Ian (Stellenbosch University, 2018-11-16), Phytoplankton variability in the Atlantic and Indian sectors of the Southern Ocean: a biogeochemical approach; http://scholar.sun.ac.za/handle/10019.1/104925

***GEOTRACES presentations in international conferences***

- Cloete R et al. Winter distribution of Cobalt in the Southern Ocean: First results from the 30˚E line. Goldschmidt, August 2018, Boston, USA (poster); Proceedings: Cloete R, Loock J, Fietz S & Roychoudhury A (2018) Goldschmidt Abstracts, 2018 447.
- Kangueehi K et al. Dust from Saldanha Bay: Assessing impact on human health and marine coastal environment. International Symposium on Medical Geology in Africa (ISMGAf), Johannesburg, South Africa, 11/2018 oral.
- Viljoen JJ, Fietz S. Southern-Atlantic phytoplankton community composition response to light and iron. POLAR 2018 (Davos), 07/2018 oral.
- Weir I, Fietz S. Phytoplankton variability in the Atlantic and Indian sectors of the Southern Ocean: a biogeochemical approach. POLAR 2018 (Davos), 07/2018 oral.

Submitted by Susanne Fietz (sfietz@sun.ac.za).