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.

- PhD students Ryan Cloete and Jean Looock 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.

- PhD student Jean Looock 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 CO₂ 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.

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.

**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.

- 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.

**Figure 19.** Asmita Singh preparing the on-deck iron addition incubation experiments.
New projects and/or funding


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.

Outreach activities conducted

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

New GEOTRACES publications (published or in press)

Main publications by SA researchers:

- 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


**Co-authored by SA researchers:**


**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**


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