RV SONNE

Cruise SO308 South Indian Ocean GEOTRACES GI07

31st October – 22nd December 2024

Durban (South Africa) – Fremantle (Australia)

4. Weekly Report

Reporting Period: 18th November - 24th November - 2024

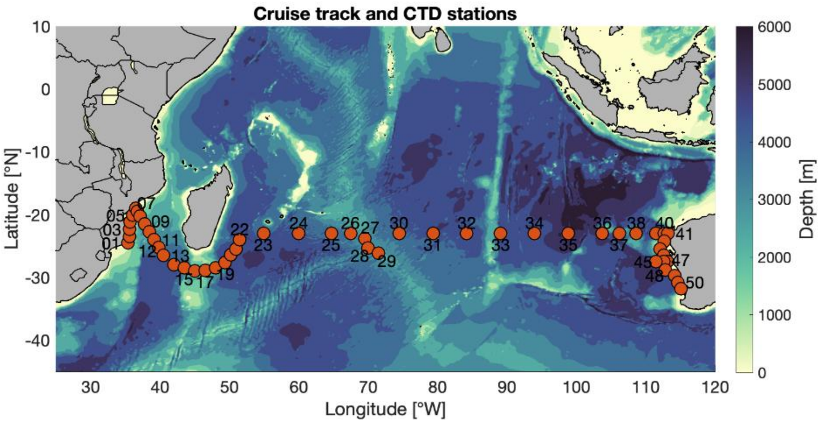

Fig. 1. The planned cruise track with 51 stations (red dots).

The GEOTRACES research cruise SO308 is three weeks underway, and we just finished sampling at station 27 (Fig. 1), which is right on top of the Edmond hydrothermal vent system. In the coming 2 days, we will also sample the Kairei and Pelagia systems (Fig. 2) before heading northeast to our track along 23°S on the way to Australia. Over the last 7 days we have sampled the waters east of Madagascar, and encountered mesoscale features with enhanced productivity. We had to alter our cruise track slightly and sailed further south along 25°36 to avoid the strongest impacts of the tropical storm Bheki which moved rapidly to the west to the north of us (towards Mauritius). We managed to successful do this, and maximum winds were not much above 7 Beaufort with waves at 4 m. All this allowed us to continue sampling operations.

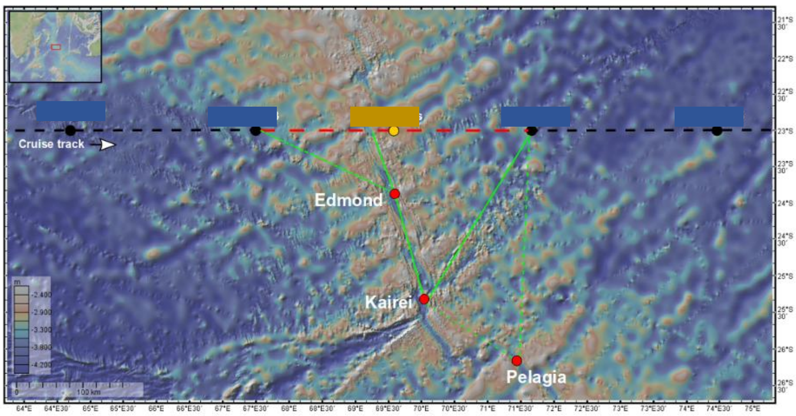

Fig. 2. Positions of hydrothermal vent systems on Central Indian Ridge (stations 27-29).

The sampling today above the Edmond vent system revealed signals in the turbidity at around 2500-2800 m, and also black and brownish filters at these depths. In addition, strong methane signals were associated with the hydrothermal plume. We will be able to identify the hydrothermal plumes using the helium isotope tracers. We have been sampling for helium isotopes in waters deeper than 1000 m since the Mozambique Channel and will use this conservative tracer to follow the hydrothermal plume and assess trace element (notable iron and manganese) inputs from the vents. We collect the samples in copper tubes, which are totally gas tight, with subsequent analysis at the University of Bremen.

The stations will be close together in the next 2 days (ca. 90 nm), with longer distances between stations until we reach the Australian slope and its Leeuwin current.

Radium measurements in the ocean

For many people, radium brings to mind Marie Skłodowska-Curie and her historic discoveries and the dangers they posed. But radium is found everywhere on our planet—in rocks, sediments, and water— in such minute amounts it cannot harm us. Several isotopes of radium exist naturally in the environment. They decay at different rates, Cátia Ehlert von Ahn from the Leibniz Centre for Tropical Marine Research (ZMT) can use them to investigate different processes occurring on short term (days, like porewater exchange) and long term (years to decades, like ocean water mass transport).

Radioactive elements constantly decay, and are thus quantified in terms of activity, or the rate of decay. In the case of radium, Cátia measures four different isotopes of radium (Ra 223, 224, 226, 228) with half-lives ranging from 3.4 days to 1600 years.

Figure 3: Containers holding hundreds of liters of water that need to be filtered through the manganese fiber. Photo by Cátia Ehlert von Ahn.

Since radium is found at such low levels in the environment, we need to process a lot of water to measure radium activity. For radium measurements in surface waters, we use a submersible pump 600 liters of water into containers (Fig. 3) which is subsequently pumped over the manganese filters. For greater depths, we use our in-situ pumps, which are lowered to depths of up to 800 m during SO308 and pump over 1200 liters of water during their 3 h deployment. Both pump systems are equipped with filters/fibers coated with manganese oxide to allow adsorption of the radium from the water.

On board, the fibers are analysed on a radium decay coincidence counter (RaDeCC) (Fig. 4). The RaDeCC pumps helium through the filters to transport radon (Rn), generated from the captured radium, through a scintillation cell where the Rn decay is counted. This provides the activity measurements that is used to evaluate the activity of radium isotopes in the water.

The measurements Cátia makes onboard only capture the decay of short-lived radium isotopes. She will take other measurements back at ZMT of each sample to measure the activities of radium isotopes with longer half lives.

Piecing together the activities of different radium isotopes at various locations and depths along the cruise transect will enable the identification and quantifications of element sources and fluxes from continental margins to the open ocean as well as provide insights into water mass movement, which has major implications for the transport of chemical species. Our initial (not yet corrected) measurements of 224 Ra in surface waters along our cruise track are shown in Fig. 5. A little radium goes a long way when it comes to understanding element sources!

Figure 4. Cátia checks the readout of Rn decay from the RaDeCC. Photo by Charlotte Eckmann.

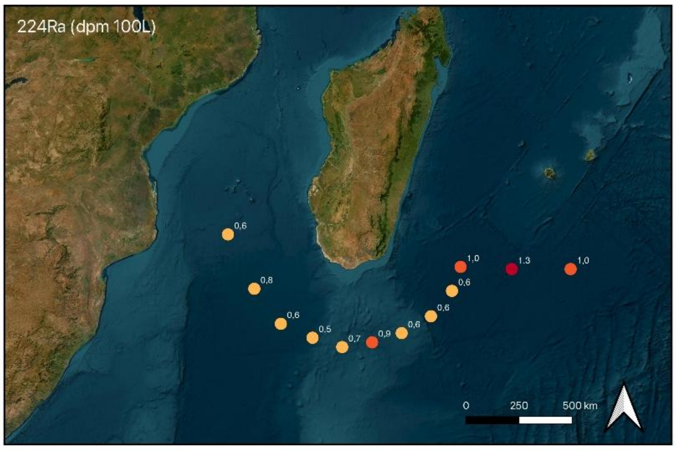

Figure 5. 224 Radium activities in surface waters along our cruise track. Preliminary and uncorrected data from Catia von Ahn.

RV SONNE at sea 24°33 S/69°48 E

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