GEOTRACES SO298

RV SONNE

Cruise SO298 “Equatorial Pacific GEOTRACES GP11”

April 14 - June 2, 2023

Guayaquil (Ecuador) - Townsville (Australia)

2nd Weekly Report (April 17 – 23, 2023)

After some delays with container delivery and re-fuelling, we were able to leave the port of Guayaquil in the evening of April 14, and start cruise SO298.

Fig. 1: Titanium CTD frame comes on deck. Photo: A. Hollister.

We had to sail south of the marine parks of the Galapagos Islands and Hermandad, and are now in international waters on the equator and will keep sailing west towards Papua New Guinea and then Australia. We are 9 days into the cruise, and are sampling at station 11 this evening. The weather is very kind to us with low winds, pleasant temperatures and occasional strong rain. We expected to sail with the equatorial surface current to the west, as this current is found typically on the equator. However, the current is at the moment against us with speeds of up to 4 knots, which slows us down. This current appears to be the Equatorial Undercurrent, which typically is found at a depth between 100-300 m, but at this moment comes to the surface in the eastern equatorial Pacific and supplies us with plenty of nutrients.

We have established a very efficient routine of equipment deployment and sampling. The team on board the SONNE is very organised and effective. Each day we sample in detail the water column from the surface ocean to the seafloor, and collect waters and particles. We use a titanium CTD rosette frame (Fig. 1) for contamination prone elements. The stainless steel CTD frame is used for non-contamination prone sampling of elements and isotopes like radium, thorium, uranium, rare earths and neodymium. This CTD is also used for sampling of microbial communities. At 3 degrees spacing, we occupy a station at which we spend ca. 6 hours with the deployments of the titanium and stainless steel CTDs. Every 3 days, at our superstations, we also add an additional stainless steel CTD cast, and deploy 7 in situ pumps to a depth of 750 m for particle collection. At the superstations we spend up to 9 hours. Florian Evers, Mario Müller, Anton Theileis are working hard every day in deploying the CTDs, camera systems and in situ pumps.

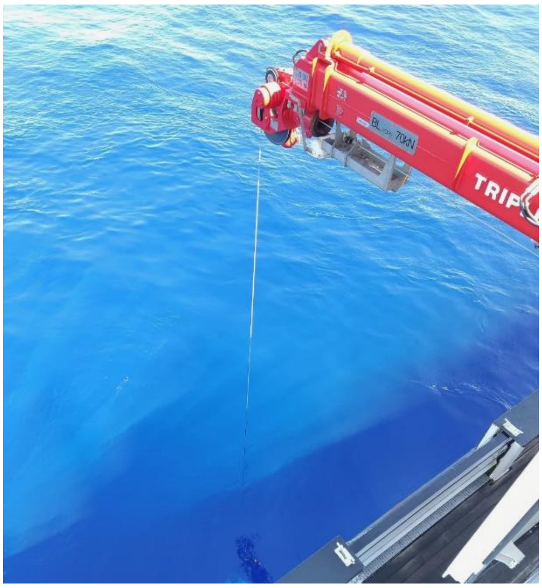

Figure 2: Sampling of particulate organic matter using in-situ pumps positioned at different depths. Photo by Stephan Hamisch

Particles in the ocean: The equatorial Pacific Ocean is one of the most remote and least explored ocean regions of our planet. The eastern side has supply of nutrient-rich (i.e. nitrate) subsurface waters which cause enhanced productivity that will ultimately be constrained by the supply of the micronutrient iron. Iron is required for phytoplankton growth, but the delivery by subsurface waters in our study region is unfavourable relative to nitrate supply. The subsurface water supply is enriched in CO_2 and the upwelling is therefore resulting in a flux of CO_2 from the ocean to the atmosphere. We are assessing the transfer of carbon (and trace elements) to the deep ocean, using the ^{234}Th (Thorium) disequilibrium technique. The debris of dead phytoplankton cells sinks from the surface ocean to greater depth. Typically, ocean regions with a high primary productivity will have a higher sinking flux of organic matter. The upwelling of subsurface waters along the equator in the Pacific will increase productivity and result in a transfer of particles to the deep ocean.

The overall process of atmospheric CO_2 uptake by phytoplankton, and the transfer of this carbon to depth is called the biological carbon pump. We are assessing the efficiency of the biological carbon pump through the removal in the upper ocean of the ^{234}Th (thorium) isotope by adsorption onto sinking particles; ^{234}Th is produced in the ocean from ^{238}U (uranium) decay. We also assess the remineralisation processes in the deep ocean by collecting organic particles and genomic material using in situ pumps, and then study the changes in particle characteristics with depth.

Particles are collected for analysis of 234 thorium, organic carbon, nitrogen and phosphorus, biogenic silica, aminoacids, aminosugars, lipids, nitrogen and carbon isotopes, barium and silica isotopes, and also mineralogy, genomics and proteomics. All these variables will be analysed upon our return to the home laboratories.

We use in situ pumps (Fig. 2) to collect particles. The seven pumps are deployed at different depths (between 15 and 600 m) on the CTD wire and allowed to pump waters over filters of 1 µm and 51 µm. The pumps manage to filter nearly 2000 l water over the two filter during their 100 min deployment. The particle observations using the pumps will be compared to measurements of particles conducted with our in situ cameras (UVP5 and PISCO).

RV Sonne at sea 0°S/104.0°W

Eric Achterberg
(GEOMAR Helmholtz Centre for Ocean Research Kiel/ University of Kiel)

You can follow our Ocean Blog at: http://www.oceanblogs.org/so298