SO298

RV SONNE

SO298 "Equatorial Pacific GEOTRACES GP11"

April 14 – June 2, 2023

Guayaquil (Ecuador) – Townsville (Australia)

5th Weekly Report (May 8 - 14, 2023)

We are now just over 4 weeks into our cruise programme, and sailing along the equator at 167°W towards the second island group of Kiribati (Fig. 1). We are still sailing into the currents, but they have decreased in strength and we are now picking up more speed.

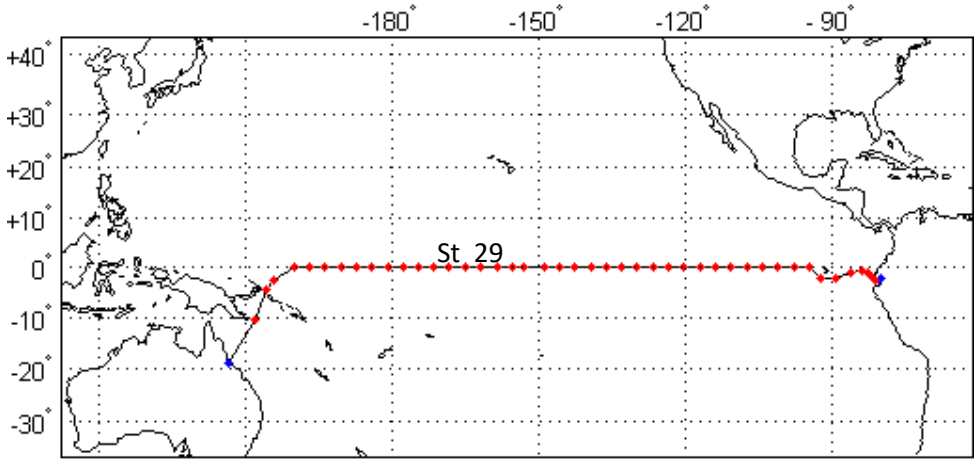

Fig. 1: Map of Pacific Ocean with our cruise track (black line), stations (red dots) and current station 29 indicated.

Fig. 2: A Shark inspecting RV SONNE. Photo by Anton Theileis.

We just passed the US island of Jarvis, with its marine park. In the EEZ of Jarvis we needed to watch for whales as part of our research permission. Many hours of whale watching were conducted by our amateur biologists, but no whales spotted. We have been enjoying plenty of flying fish and also sharks (Fig. 2), but whilst steaming west, the ocean productivity is decreasing and so are the number of sightings. Unexpectedly, we are still sailing through surface waters affected by the Equatorial Undercurrent (EUC). This provides nutrients to the surface ocean. We are therefore still sampling surface waters with nutrient concentration of 3 µmole/kg nitrate (Fig. 3).

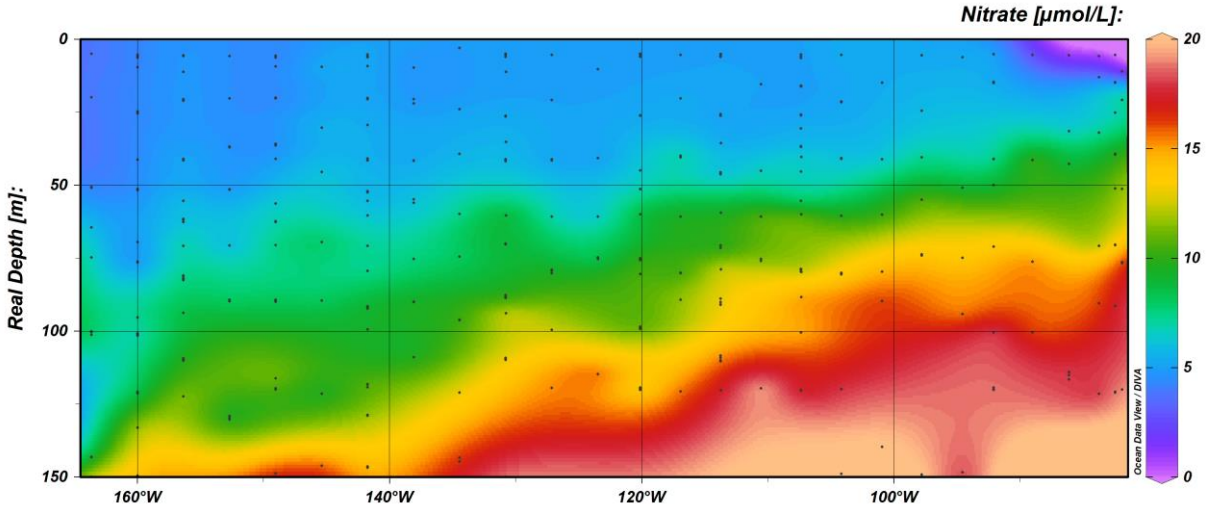

Fig. 3: Nitrate data in surface waters (top 150 m) along cruise track. Data provided by Andre Mutzberg and plotted by Angele Nicolas.

The microbial communities are consequently limited by the availability of iron, and there is likely a very low level of di-nitrogen fixation. Our researchers on the Sonne (in particular Zhongwei, Ze and Brandy) are waiting for the transition to nitrate depleted waters, which we expect further west.

Light measurements above the ocean

As a part of the European Research Council project of Tom Browning, called 'Ocean Glow', we are deploying multiple sensors (radiometers and irradiance meters; Fig. 4) to measure the passive fluorescence signal coming out of the ocean.

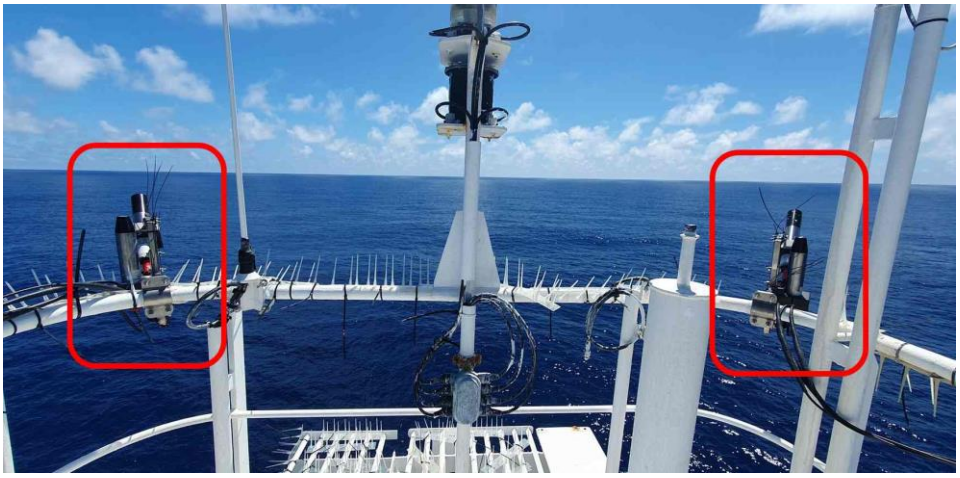

Figure 4: Radiometers on the mast at the front of RV Sonne.
Photo: Brandy Robinson

Brandy Robinson is using the radiometers to measure the radiant flux (power) of electromagnetic radiation, i.e., the energy of the light. Brandy deploys hyperspectral radiometers which measure a range of wavelengths in the electromagnetic spectrum from 300 nm to 900 nm, and obtain a very high resolution signature of the light coming from the ocean. We also have radiometers pointed at the sky and irradiance meters measure the total amount light coming in. This information is used to calculate the fluorescence light (Fig. 5) being emitted by phytoplankton in the surface ocean from their photosynthetic pigment chlorophyll *a*.

During photosynthesis, phytoplankton re-emit light and the specific fluorescence characteristics of the light can be used to assess whether phytoplankton are stressed by a low supply of iron.

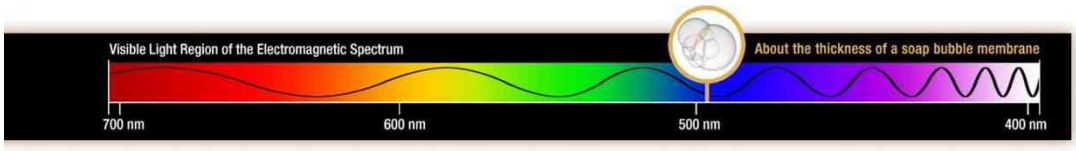

Fig. 5: Visible region of the electromagnetic spectrum. Credit: NASA.

During SO298 Brandy is recording the passive fluorescence signature coming from the ocean as we move through the iron limited waters towards iron and nitrogen co-limited and nitrogen limited waters towards the western equatorial Pacific and assess how the fluorescence signature changes. The plan is to use this data in future, in combination with satellite data to obtain global assessments of different nutrient regimes in the ocean via phytoplankton fluorescence signatures.

Dissolved aluminium

On board of the RV SONNE, Naman Singh is conducting measurements of dissolved aluminium in the water column. Results for station 18 (0°S/128°W) are shown in Figure 6, and indicate quite low concentrations in the surface waters which mean that the atmospheric inputs of dust and other terrestrial particles are low. Aluminium in the surface ocean is a commonly used tracer for dust inputs, as lithogenic particles contain up to 8 % aluminium (by weight) and a little of this aluminium will dissolve when particles are deposited in the surface ocean. We are far away from land (and deserts) and the atmospheric inputs are small, resulting in low surface levels.

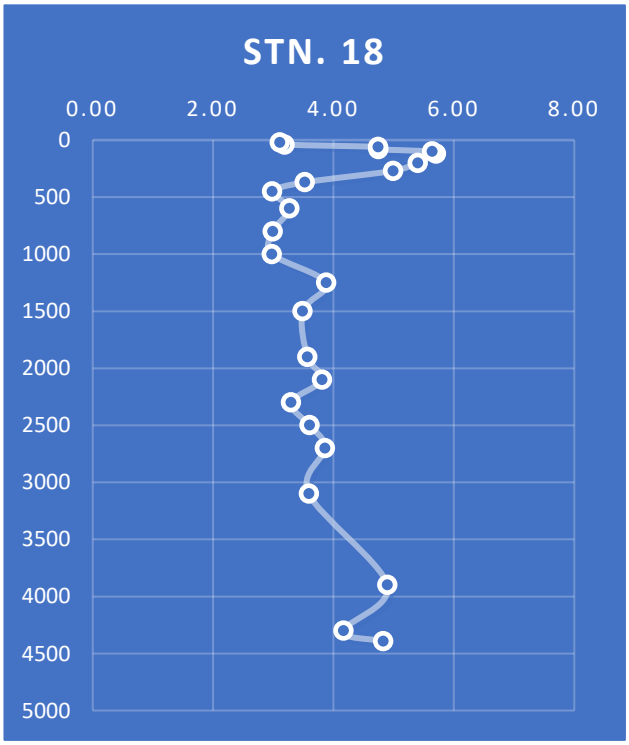

Fig. 6: Profile of dissolved aluminium in the equatorial Pacific at station 18. Preliminary data from Naman Singh.

The depth profile shows enhanced concentrations in subsurface waters between 60 m and 270 m, which is the depth range of the EUC. The EUC thus carries waters enriched in dissolved aluminium from the west Pacific to the east Pacific. The aluminium in the EUC is ultimately derived from sediments and river run-off in the western Pacific. The profile also shows increased concentrations towards the seafloor which are associated with inputs from seafloor sediments

RV SONNE at sea 0°S/167°W

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