SO290 Paleoceanography of the Tasman Sea

RV SONNE

SO290 – Paleoceanography of the Tasman Sea

15th April – 12th May 2022

Nouméa (New Caledonia) – Nouméa (New Caledonia)

3rd Weekly Report

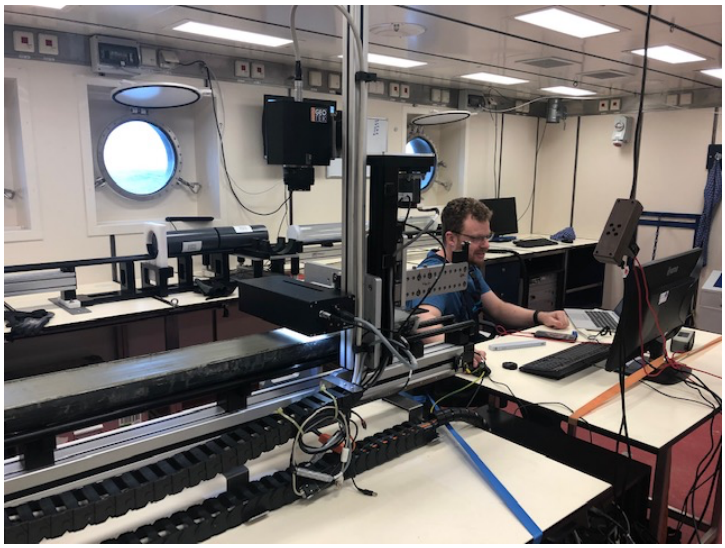
(25th April – 1st May 2022)

After abandoning station work along our second E-W transect due to bad weather conditions, with the aim to revisit two of the sites at the end of the cruise, we slowly transited southeastward against wind and waves. We mapped the bathymetry and sediment cover of the seafloor while waiting for seas and weather to calm down and indeed found promising sedimentary cover at several deep sea locations at water depths of ~4000 to ~4500 m. Such more distal records likely provide undisturbed sedimentary sequences reaching up to about one million years back in time, and they allow to study changes of the deep water properties. However, since coring and water sampling was still not possible, we decided to make use of the remaining time and travel closer towards New Zealand. Our hope was to find sediments with a stronger terrestrial influence that would allow us to reconstruct the terrestrial climate and particularly glacier advances and retreats in the geologic past that should be recorded in the ocean by varying input of land-derived material. After deployment of the multicorer to recover the upper 20-30 cm of undisturbed ocean floor sediment, we recovered one almost 15 m and one 5.8 m long sediment core. Initial inspection of the sediments revealed abundant turbidites in the land proximal core and still some thin, distal turbidite layers in the more distal sediments. Turbidites are deposits of sediment-laden gravity-driven currents that transport large amounts of terrigenous material down the continental slope into the deep basins of the ocean. Our later analyses in the home laboratories will show, whether at least the more distal core might still provide a continuous record of past oceanographic and climatic changes.

In anticipation of the next storm and a subsequent good weather window forecast for the southern tip of the South Island of New Zealand for Wednesday, April 27, we decided to transit southward to our southernmost stations and survey additional potential coring sites along the way. Several potential coring sites were identified and their geographical coordinates noted down for later sampling on our way back north. We also used the night from the 26th to the 27th for Parasound and bathymetric surveys southwest and south of the South Island and selected three stations on the eastern flanks of the Solander Trough that is a major conduit of material eroded from the Southern New Zealand Alps and transported into the ocean. Again, our aim here is to recover sediments that document the glacial history of the South Island. These cores and records, so we hope, will eventually allow us to link the terrestrial with the marine climate using proximal and distal sediments and specific indicators and tracers that record changes on land and in the ocean.

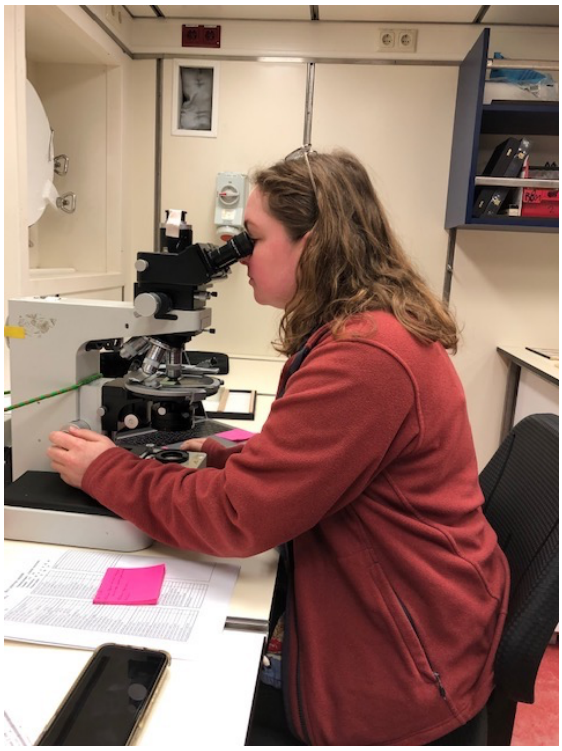
Pictures 1-2: Left: The coring team cutting a long sediment core into 1 m sections. Right: Initial collection of sediment samples from a long sediment core (photos: SO290, K.Pahnke, CC BY 4.0)

Within two days, we collected water column samples, surface sediments and long sediment cores from four stations. This efficiency is only possible thanks to the amazing team of experienced researchers and motivated students we have on board, the collaboration with the deck crew, and the smooth work flow that has become our second nature by now. The sediment cores are first cut into ~1 m long sections already on deck, capped and labeled carefully before they are left for 24 hours to allow for temperature equilibration of the sediments, which is required prior to scanning for magnetic susceptibility using our multi-sensor core loggers (see picture 3). The magnetic susceptibility provides an indication of the amount of particles in the sediments that can be magnetized and which are a typical indicator for terrestrial material. This way we gain a first look at the properties of the sediments without even haven seen them.



Picture 3: One of the multi-sensor core loggers scanning one of the core-halves, operated by Pascal Daub (photo: SO290, K.Pahnke, CC BY 4.0).

At the same time, our two nannoplankton specialists that are experts on calcareous and silicious nannoplankton (e.g., coccolithophorids and diatoms), are already preparing smear slides from the base of each 1 m core section. Using a microscope, they are able to identify so called age indicator species that got either extinct or first appeared at a certain and known time in the past (picture 4). This provides us with an initial 'biostratigraphic' age of the recovered sediments. Once the sediment cores have been scanned, they are opened, visually described and initially sampled before they are returned to the core scanners for additional data acquisition (photography and point measurements of magnetic susceptibility). Finally, the core halves are wrapped, put into so-called D-tubes and packed for shipment in a cold container back to the home laboratories.



Picture 4: One of our nannoplankton specialists, Emma Hanson, identifying tiny calcareous coccoliths under the microscope for biostratigraphic dating of our sediment cores. This is not an easy task in the first place, and even more challenging on a moving ship! (photo: SO290, K.Pahnke, CC BY 4.0)

Similarly, the hydrographic measurements and water samples require processing. The CTD team on board removes outliers and collects water samples for later calibration of the salinity and oxygen measurements of the sensors and according correction of the data. The water samples require treatment depending on the parameters that will be measured. For example, the water samples intended for trace metal and metal isotope analyses are filtered, acidified and 5-10 L are pumped over a specific resin that extracts the trace elements of interest. This procedure markedly reduces the water volume we have to ship home (from 5-10 L to a ca. 3 cm long cartridge).

Our last station in the Solander Trough was finished on April 28th at night. The magnetic susceptibility data and biostratigraphic ages suggest the base of this 970 m long core to reach

into the penultimate glacial period, which would allow us to reconstruct glacier changes in the Southern Alps over a full glacial-interglacial cycle.
We then transited back to a waypoint west of the southern tip of South Island to recover samples from a deep site (4400 m water depth) that should record both bottom water circulation changes in the Tasman Sea as well as changes in dust deposition over glacial-interglacial cycles of the geologic past. The rest of the night until midday on May 1st, we used again for surveying potential sampling sites off New Zealand's Fjordland and for weathering off a storm. This one hit us pretty hard with gusts up to 12 Beaufort. Fortunately, it passed relatively quickly, but the waves were now coming from two different directions, further hampering our sampling plans. Only water column and surface sediment sampling was possible at two preselected sites just outside the 12 mile zone of New Zealand. We will try again to collect sediment cores at these locations with the backdrop of the Southern Alps at the horizon.

Picture 5: Storm in the Tasman Sea on April 30th-May 1st. Unfortunately, such conditions are always hard to capture on a photo, particularly at night. (photo: SO290, T.Badewien, CC BY 4.0)

All participants are fine and luckily sea sickness is not a big issue anymore. However, we were all facing a very intensive work program this week and the rough seas sometimes interrupted or even completely prohibited our well-deserved night's sleep.

Greetings from RV SONNE at 45°S, 166°E!

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