



## RV SONNE Cruise SO288

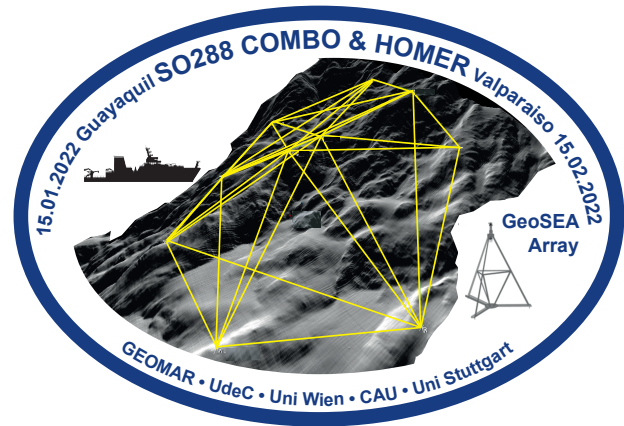
### COMBO & HOMER

15.01.2022 – 15.02.2022

Guayaquil (Ecuador) – Valparaíso (Chile)

### Weekly Report Nr. 4

31.01.-06.02.2022



### *At Sea, 20°46'S/71°04'W*

Our fourth week at sea again began with a general PCR screening, which on Jan. 31, 2022, yielded negative results for everyone on board and brought about the lifting of some of the strict safety and hygiene measures. Reflection seismic data recording continued without interruption until early morning, and initial glimpses of the data show pronounced fault structures at and below the seafloor that were also identified in the bathymetry and had been monitored by the GeoSEA Array geodetic network since 2015 (Fig. 1). These fault zones are formed when the oceanic plate bends into the deep-sea trench and are potentially able to rupture in strong earthquakes.

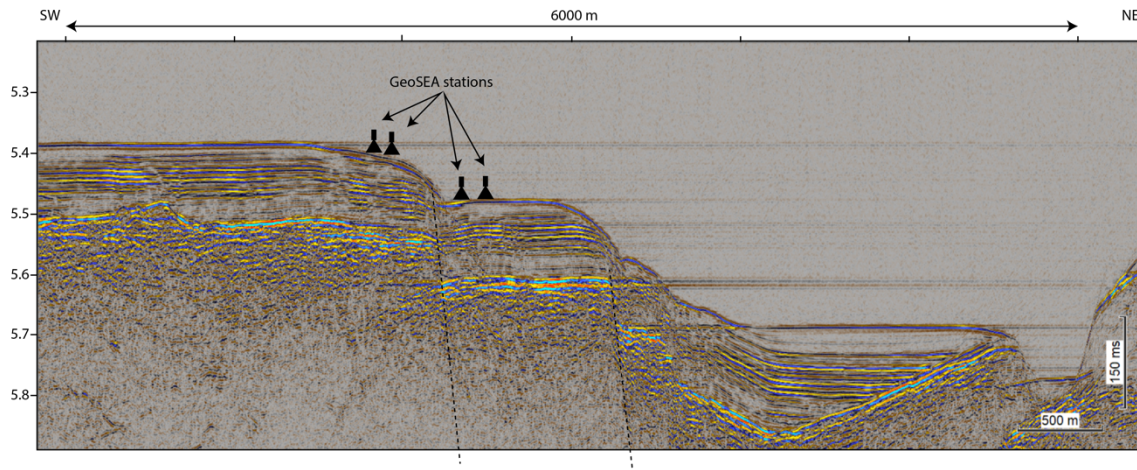


Figure 1: Seismic profile in work area AREA 2 across the pronounced normal faults beneath the GeoSEA network. GeoSEA stations are located on either side of a major fault (black dashed lines) and measure tectonic deformation and movement along the fault.

Graphic: M. Kühn, GEOMAR

For the microbiological and biogeochemical work, 4 CTD stations were cast during the day to collect additional water samples from the surface to the deep sea (4000 m) for the study of the vertical distribution of organic matter and microbial activity. An additional 240 L of water from 1500 m depth was also taken from one of the CTD stations to conduct on-board incubation experiments. In these experiments, dissolved organic macromolecules from different depths (surface and 1500 m) are concentrated by filtration and incubated in deep seawater from 1500 m with natural bacterial communities in the solar climate laboratories (Fig. 2). These experiments investigate the influence of



source, lability, composition, and concentration of organic matter on microbial processes at different temperatures relevant to organic matter turnover in the deep ocean. The total amount of organic carbon dissolved in the ocean (DOM) is roughly equivalent to the amount of carbon found in the atmosphere in the form of carbon dioxide. This means that the ocean represents a vast organic carbon reservoir. DOM produced in the surface by algae accumulates in the deep ocean after export and transformation as so-called recalcitrant DOM, i.e. DOM that is difficult to degrade by microbes, and represents an important carbon sink that partially counteracts anthropogenic carbon emissions. However, the processes affecting the microbial degradation of DOM in the deep sea are poorly understood.



Figure 2: Incubation experiments on deep-sea organic matter degradation in the climate laboratories of SONNE at in-situ temperature (2.5 °C) and elevated temperature (6 °C). Incubations are also conducted in the dark and red light is used during sampling to inhibit algae growth.

Photo: K. Becker, GEOMAR

In addition to DOM, sinking particulate organic matter plays an essential role in the ocean carbon cycle. Sinking particles or aggregates consist mainly of dead phytoplankton and transport organic carbon from the surface to the deep sea. Thus, they have a direct impact on climate. In addition, aggregates are a potential food source for zooplankton and other organisms. To investigate the distribution of particles in the water column, an underwater vision profiler (UVP) installed at the CTD has been used at all CTD stations conducted to date, which quantifies particles and zooplankton simultaneously (Fig. 3).

Figure 3: Example images of plankton and aggregates imaged with the Underwater Vision Profiler.

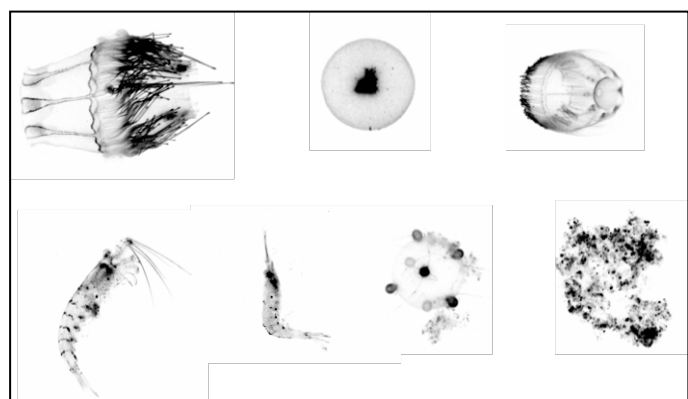


Photo: K. Becker, GEOMAR

After completion of the CTD stations, a short transit of 45 nm to the third work area followed. Here, six ocean bottom seismometers were installed for the refraction experiment on the evening of 31.01.2022 (Fig. 4).



Figure 4: An ocean bottom seismometer (OBS) is launched after a short float test. OBSs record the energy generated by air pulses traveling through the oceanic crust and into the Earth's mantle. They are installed free-falling on the seafloor and can be recovered by an acoustic signal that releases the anchor. OBSs then rise independently to the water surface. The data are stored on the instrument on a data logger.

Photo: S. Kontradowitz, GEOMAR

On 01.02.2022, during the fifth dive on SO288, we suddenly lost communication and control to the Remotely Operated Vehicle Kiel 6000 (ROV) without any prior indication. The ROV was at a water depth of 5100 m at the time. It was only due to the many years of expertise of the ROV technicians that an emergency rescue plan could be drawn up very quickly and troubleshooting could be started during the recovery. The recovery under difficult conditions without own control of the ROV succeeded in the late afternoon.

The following 36 hours until the morning of 03.02.2022 were dedicated to the seismic work program to record both high-resolution reflection seismic and low-frequency refraction seismic (deeper penetrating into the Earth's layers). Subsequently, the ocean bottom seismometers were recovered and additional CTD stations and an *in situ* incubator experiment were run during the night of 04.02.2022. During this entire time, the repair work on the ROV was running in parallel, which partly resembled an 'open-heart surgery' and confirmed the internationally excellent reputation of the ROV team, whose work not only in the water, but also on deck is decisive for the achievement of the research objectives. Thus, the ROV could be launched again on 04.02.2022 and recovered three GeoSEA stations from water depths of more than 5200 m until the evening. An extensive reflection seismic program began in the evening and continued over the next three nights, followed by ROV dives during the day. By 06.02.2022, more than 640 km of seismic data were recorded and an additional four GeoSEA stations were recovered in two more dives.

Despite the adverse conditions of cruise SO288, we are thus decisively closer to achieving our scientific goals and are excited about the coming week.

Everyone on board continues to be well and happy about the partial lifting of the strict and restrictive restrictions of the last weeks.

Greetings from aboard the SONNE on behalf of all cruise participants,

Heidrun Kopp  
Wissenschaftliche Fahrtleitung

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel