Research Vessel SONNE

SO266:

Kaohsiung – Kaohsiung

Third weekly report: 28 October – 4 November 2018

The more than 100 m deep borehole on Four Way Closure Ridge resulted in more than 90.6% core recovery and kept us busy in the laboratories last weekend. Based on pore water chloride data, the geochemists were able to show that from 70 m below the seafloor, negative anomalies occur at several depth intervals, which can be explained by small but significant methane hydrate accumulations at those depth. The temperature of each core was measured with an infrared camera immediately after the core had been retrieved from its core barrel. This fast measurement of the still unopened liner indicates discrete gas hydrate accumulations by a temperature that differs significantly from the overall core (Fig. 1). As gas hydrates are not stable at the pressure/temperature conditions aboard the ship, they decompose into their components, i.e. water and methane. This fairly rapid decomposition is an endothermic reaction that consumes heat from the immediate environment. As a result, we saw pronounced cold sections of the core. Since we scanned all cores from the seabed drilling rig with this fast method, methane hydrate accumulations above a certain gas hydrate concentration were detected very well and the intervals coincided with those for which the geochemists found the chloride anomalies. Then, all sediment cores were logged with the multi-sensor core logger before they were split into archive and work halves (Fig. 2). Our Taiwanese colleagues from TORI (Taiwan Ocean Research Institute), a national institute in Taiwan similar to our Helmholtz institutions in Germany, provided the logger in a laboratory container for this cruise. On a calibrated bench (Fig. 2) physical properties of the cores, such as density, magnetic susceptibility, conductivity and P-wave velocity are measured. These data are in turn compared with the other data from the core description, the geochemical data and the high-resolution 3D seismic data.

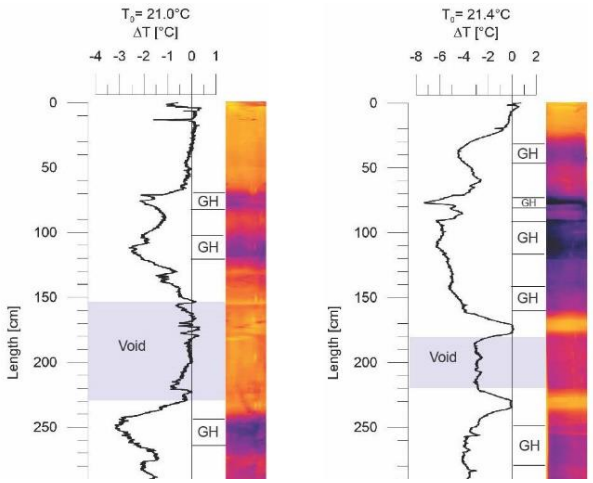

Figure 1: Infrared measurements of two Mebo sediment cores using an IR-camera. Cold intervals with temperature anomalies of 2 - 8 ° C indicate the locations of the gas hydrate deposits in the cores just after the cores have been retrieved. (© Bryan Niederbockstruck).

Figure 2: Before the sediment cores are separated lengthwise and sampled, they are examined for their physical properties using the multi-sensor core logger in the container from TORI Institute of Taiwan (© Paul Wintersteller).

Very helpful for the localization of previously existing gas hydrates are also the measurements of the ratios of light hydrocarbons of gas samples, which are obtained with a special syringe from gas bubbles in the sediment liners. In sediment sections with methane hydrate, the ethane/propane ratio is significantly higher, since ethane is incorporated into the gas hydrate structure and is released again during hydrate

decomposition. In contrast, propane is not incorporated in the gas hydrate structure and accumulates in gas hydrate-free sediment sections.

As of Monday, October 29, we were impacted by the approaching super-typhoon YUTU, which had wind speeds of up to 195km/h and caused a strong to stormy north-easterlies in our working area. In our northwestern working area on Formosa Ridge station work was no longer possible. In the lee of Taiwan in our eastern working area, we were still able to perform station work with OFOS, CTD and gravity corer. Unfortunately, on Tuesday we were expelled also from this area by a short-term military drill, so we had to move closer towards the Taiwanese coast to remain in a relative quiet area, 13 nautical miles off the coast. On Thursday, November 1, the typhoon reached the South China Sea on its westward course, sweeping across the Philippines with wind speeds still up to 140 km/h and sadly doing a great deal of damage. We stayed in the lee of Taiwan at the safe distance (Fig. 3), but registered significantly increased wind speeds and wave movements. On Friday, October 2, after the cyclone abated, we conducted further station work on Four-Way-Clousure Ridge with OFOS, CTD, and gravity corer (Fig. 4). However, it was too early for a new MeBo mission, as there was still a strong swell from various directions, as a remainder of the typhoon, that prevented the deployment of the drilling system.

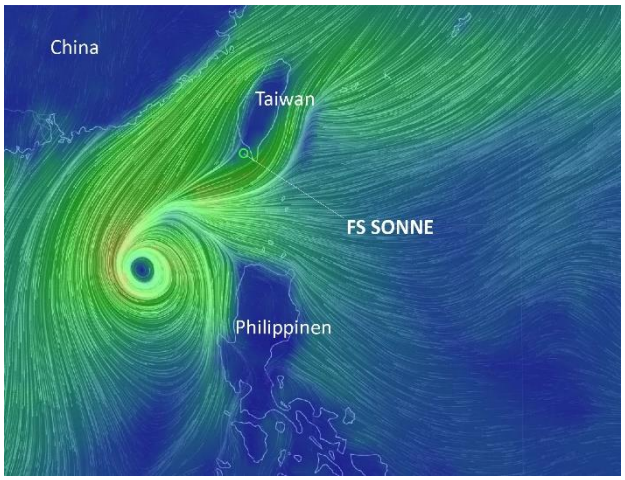

Figure 3: On Thursday, November 1, the already weakened Typhoon YUTU came closest to us. We therefore chose with RV SONNE the quietest corner in the southern lee of the island of Taiwan (©https://earth.nullschool.net/#current/wind).

Figure 4: Scientists of the SONNE expedition sampling a core in a bag on the working deck. The use of a tubular bag instead of a plastic liner allows a much faster access to the sediments after the core has been hoisted on board (© Paul Wintersteller).

On Saturday, November 3, all signs of the typhoon had disappeared and we were able to launch the MeBo in bright sunshine. The positioning of the drilling system on the seabed was very difficult due to the geological conditions. The seafloor was very hummocky due to numerous limestone blocks. The ship's photo and video sled (OFOS) had revealed only a few flat areas of about 10 m in diameter, in which a landing was possible. A new sonar called Echoscope helped us to find such a place. The Echoscope, which can see through a hatch in the bottom plate of the MeBo, is a sonar that provides in real time a very good 3D representation of the seabed. Using this technology from 40 m above the seafloor allowed us to find a suitable location on which the MeBo could land safely. The subsequent rotary drilling had to be stopped after 5.06 m due to gas bubbling from the well. A very well-preserved sequence of typical seep limestones with more than 85% core recovery, could be obtained.

A hump day party in the hangar of the ship on Wednesday, October 31, rounded off the first half of the journey, and we are looking forward to the scientific results of the second half. Everyone is healthy; it greets in the name of all cruise participants

Gerhard Bohrmann FS SONNE, Sunday, 04 November 2018