Weekly Report POS530 MineMoni

8th– 14th October 2018

During the second week of the MineMoni cruise we proceeded with our research program in the Fehmarn Sund area.

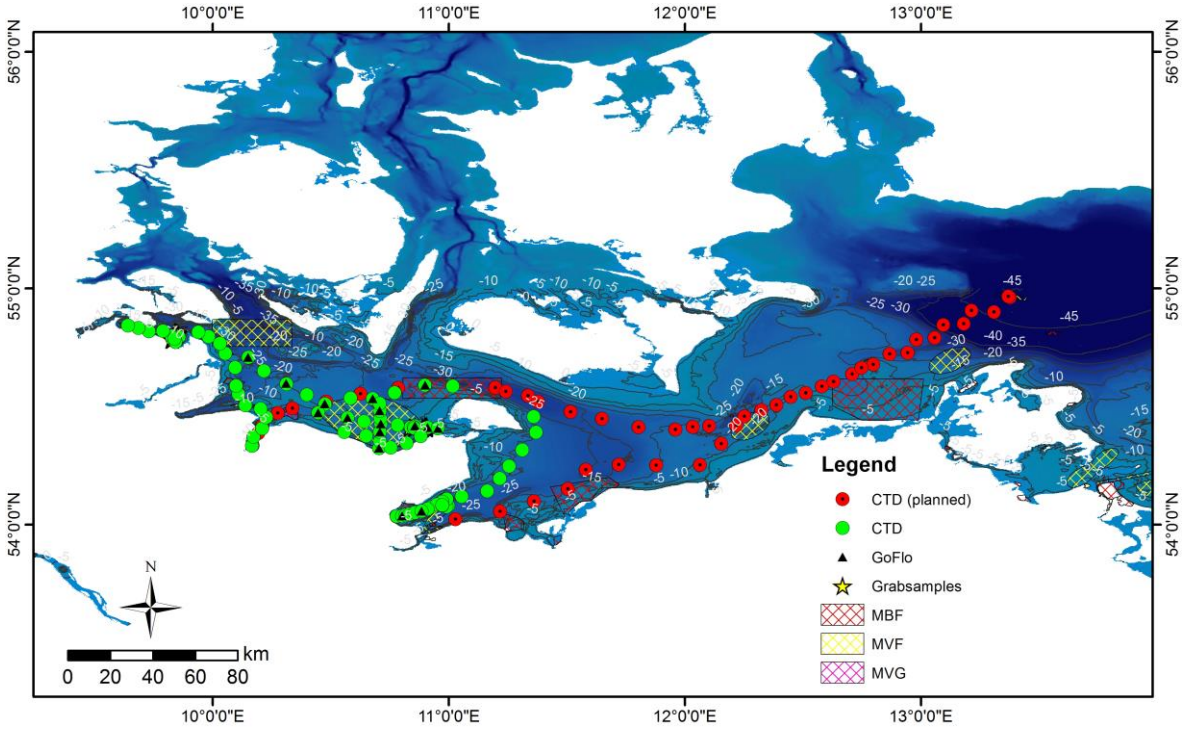

Figure 1: Overview map of the cruise track, with stations already done (green) and those that will follow (red).

After mapping the Fehmarn Sund area, we arranged the field program according to our findings from the multibeam data. To be able to create a habitat classification it is essential to acquire a good set of ground truth data. Therefore we did visual ground truthing with the AUV and TV-CTD, as well as grab samples in different backscatter regimes. After sampling the dark and smelly mud in Geltinger Bay, it was a relief to sample the sandy area of Fehmarn Sund. The sediment here is mainly composed of fine to medium sand with worm tubes on the surface (Figure 2). Formed by currents going through the Fehmarn Sund, we observed fields of sediment ripples in the high-resolution multibeam data. They reach a crest height of ca 15 cm and lengths of 120 cm. To show the influence of the ripple direction onto the sonar data, we ran several multibeam lines over the same ripple field from different directions. Only the ripple-parallel tracks could resolve the characteristic ripple structure, whereas the seafloor seemed to be homogeneous when driving parallel to the ripple's aspect.

Furthermore, we used the time for more detailed testing and to evaluate the best settings to gain high resolution images of mines on the seafloor. Therefore we gave the watch officers a hard time as we asked them to precisely steer the vessel following a star-like pattern over one mine (Figure 3). With a narrow swath, low pulse length and high ping rates the effort paid off and resulted in 10 cm

resolution images of a ground mine. This allows us detailed morphological analysis of the mine's size and shape.

The research site is actually partly located inside a firing range of the German Navy in Todendorf. During the day we were not allowed to enter the area, due to ongoing shooting tests. But during the night of the 7th and also the 10th October we took the chance and took N-S and E-W – transects of CTD water sampling- and GoFlo stations. As this is an active testing site, higher concentrations of explosive compounds within this area are expected.

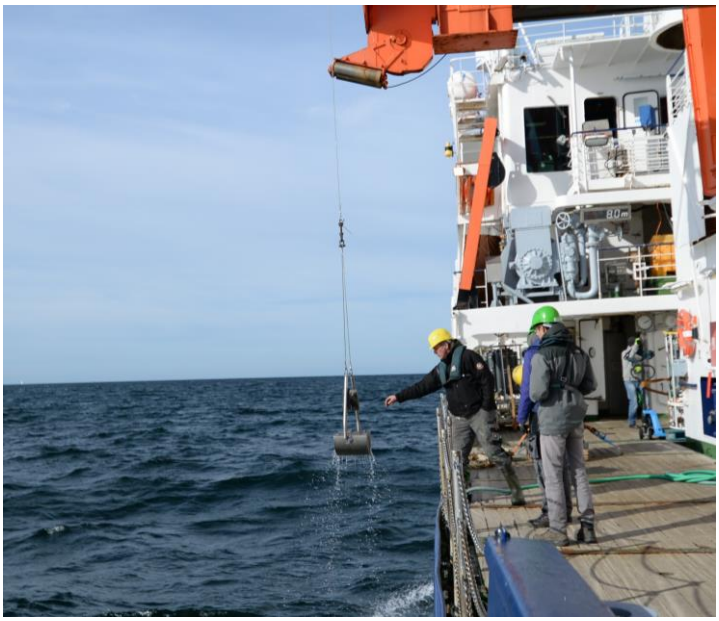

Figure 2: Using a VanVeen – grab to get seafloor samples. The sediment is sampled for grain size and porosity analysis, such as for chemical studies.

On the 10th of October, scientific divers from CAU Kiel came back for the second time. The shuttle from Heiligenhafen was done by the THW Ratzeburg and turned out to be a nice boat ride in the sunrise from Neustadt to the 10 m water line where POSEIDON was waiting. Again we had best weather conditions for three dives in total. Two mussel moorings were set out and installed next to two suspicious objects in 13 m water depth (Figure 4).

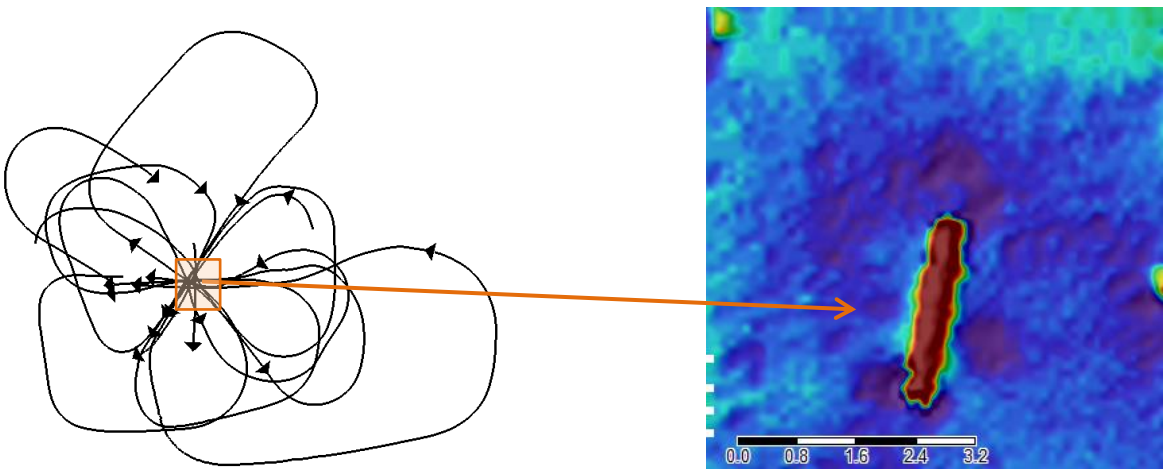

Figure 3: Challenging the driving skills of the vessel's officers: One mine (2.5 x 0.5 m) had to be crossed from different angles. Crossing such a small target with the 60 m long and 12 m wide RV POSEIDON, requires concentration and precise navigation.

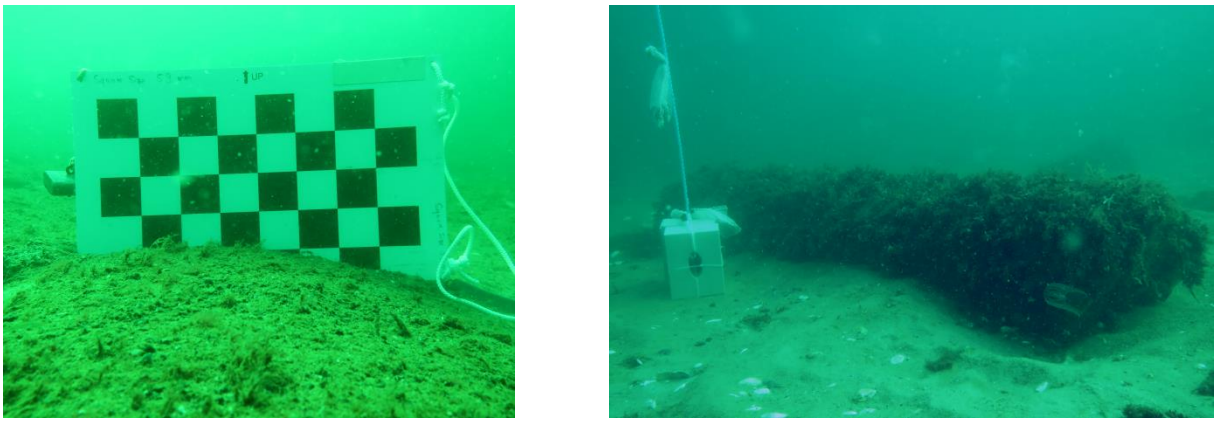

Figure 4: Underwater targets for the scientific divers: measuring the height and length of sediment ripples and installing a mussel mooring next to a ground mine.

In the evening, the THW boat returned to pick up the divers and brought 3 more crew members and we left the area after six days. Two of new crew members, Jens Sternheim (MELUND) and Uwe Wichert (external consultant) work for the German expert panel 'Expertenkreis Munition im Meer' of the BLANO (Bund Länder Ausschuss Nordsee Ostsee) and can provide detailed historic knowledge about possible munition dumping areas within the Baltic Sea. According to their expertise, a spontaneous mapping session on the eastern side of Fehmarn Island was fit into the night schedule. The area from Staberhuk is a special historical point. At the end of April 1945, submarine school flotilla, auxiliary-ships and merchant ships anchored along the south-east side of the Island of Fehmarn. A massive air attack with fighters from the Royal Air Force hit the ships with guns, rockets and bombs. The ships were damaged or sunk, with a high number of seriously and fatally injured crewmembers. The wrecks were recovered after the war, but ammunition from the attack contaminated the waters around the fighting area. Misfired ammunition and contaminated areas are both of interest within this research operation.

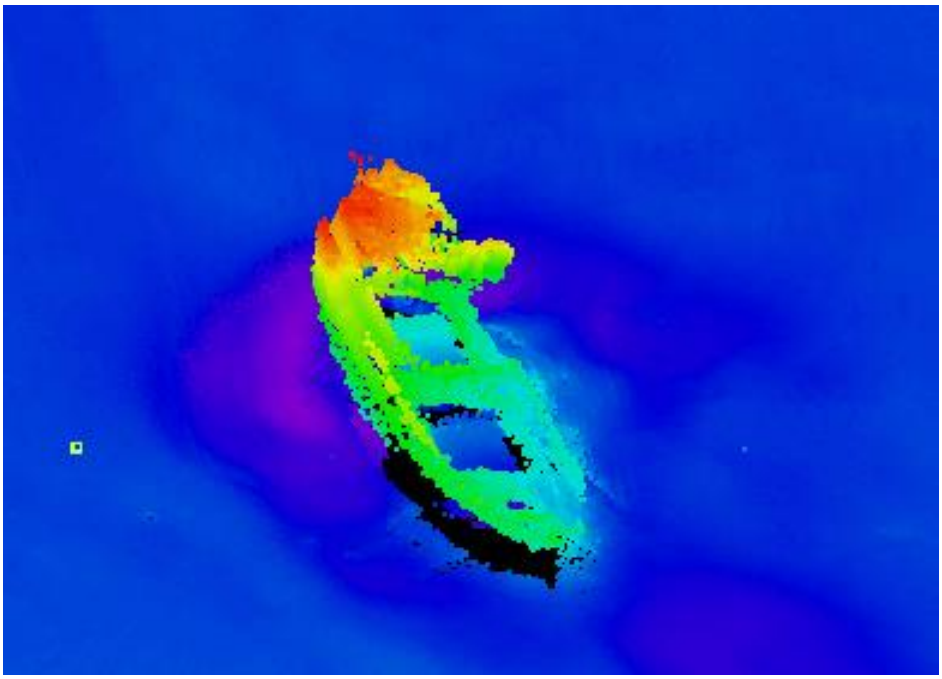

Figure 5: Bathymetric data showing a coastal freight vessel of 28 m length, sitting upright on the seafloor.

Uwe's nickname - "He, who knows every mine by its first name" - gives an idea about the knowledge he has. Happy to share this knowledge with others, he gave a presentation for the crew members and explained how munition was dumped in the Baltic Sea.

After WW II, the Allied forces established 5 dumping areas along the coastline of Schleswig- Holstein, two of which in Lübeck Bight. At first, the area at Pelzerhagen was used, but a short time later, the second place Haffkrug became the primary dumping location. Both areas lie a short distance to the merchant harbours of Lübeck, and transport possibilities with trucks, railway and river barges were short and in relatively good condition.

In the time from 1945 to 1949 approx. 50.000 tons of ammunition were dumped in the area Pelzerhagen and in Haffkrug 10.000 tons. The spectrum of the ammunition includes all kinds, from rifle cartridges to a 1400 kg bomb or a 1.000 kg anti invasion mine. The last dumping action occurred in January 1949, with 700 tons old ammunition from the Royal Air force. At the beginning of the fifties, a new idea was born and implemented. The dumping ground was covered with 'Gicht' blast furnace slag and fly ash. Till 1961, a civil company got the permission to recover ammunition and nearly 15.000 tons were recovered. Dangerous, not portable recovered parts were destroyed by explosion or re-dumped with the problem that the borderlines of the area were changed. Today, we have no detailed information of the measurements and borderlines of both areas and no information about the condition of the old ammunition. In accordance with the order from Expertenkreis Munition im Meer, research for the detailed newest information is ongoing with the operation.

By the evening of October 14th we had mapped both dumpsites in Lübeck Bight. Directly on the first multibeam profile we crossed a 75 x 180 m large mound composed of suspicious elongated objects. A TV-CTD profile across this area revealed several grenades and ammunition boxes, but due to the poor visibility at 23 m water depth, the total amount could not be verified.

The acoustic backscatter in this area is particularly reminiscent of a moon crater landscape. The whole area is covered with small shallow craters of unknown origin and patterns resembling strings of pearls (Figure 6).

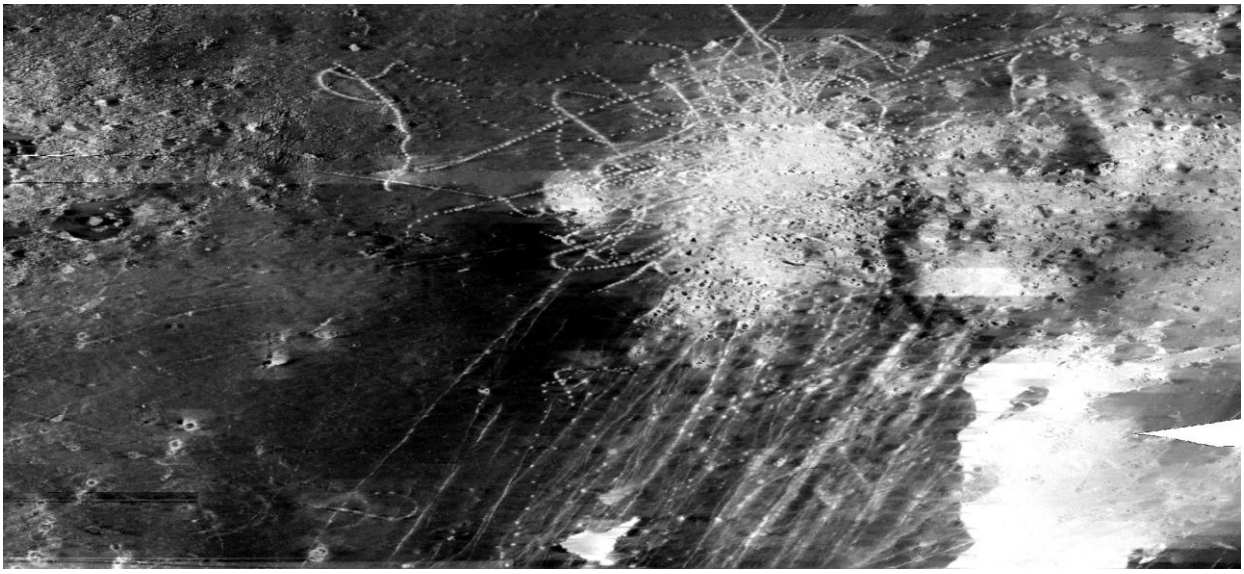

Figure 6: Outcrop of the backscatter map of the dump site in Lübeck Bight. Craters of various sizes and pearl string like pattern characterize this area.

In addition to the main dump site, another one exists closer to shore. In this more southern site we were hoping for better water conditions and sent the AUV 'Anton' onto his next mission. The footage that was collected was immediately pre-analyzed by Uwe and also shows grenades, ammunition boxes and explosive charges. In short, we do not have problems to find good targets for the coming diver missions and the deployment of our mussel bags.

With respect to the water column, data from the CTD profiles show saline water flowing into the deep western Baltic Sea, following the seafloor bathymetry to spill into Geltinger Bay, Eckenforder Bay, and the deep basin west of Fehmarn (Fig. 7). A deep saline lens continues around Fehmarn and into Lübeck Bight. Within the Geltinger Bay and Lübeck Bight, oxygen concentrations are severely reduced relative to the nearly saturated levels observed in most other deep waters of the southwestern Baltic (Fig. 7). Within the Lübeck Bight, dissolved oxygen approaches 10 µM, only about 3% of the saturated value. Here, oxygen concentrations are so low that we observe apparent bacterial mats of Beggiatoa, a giant filamentous bacterium that breathes sulfide and nitrate, and lives only in the absence of oxygen.

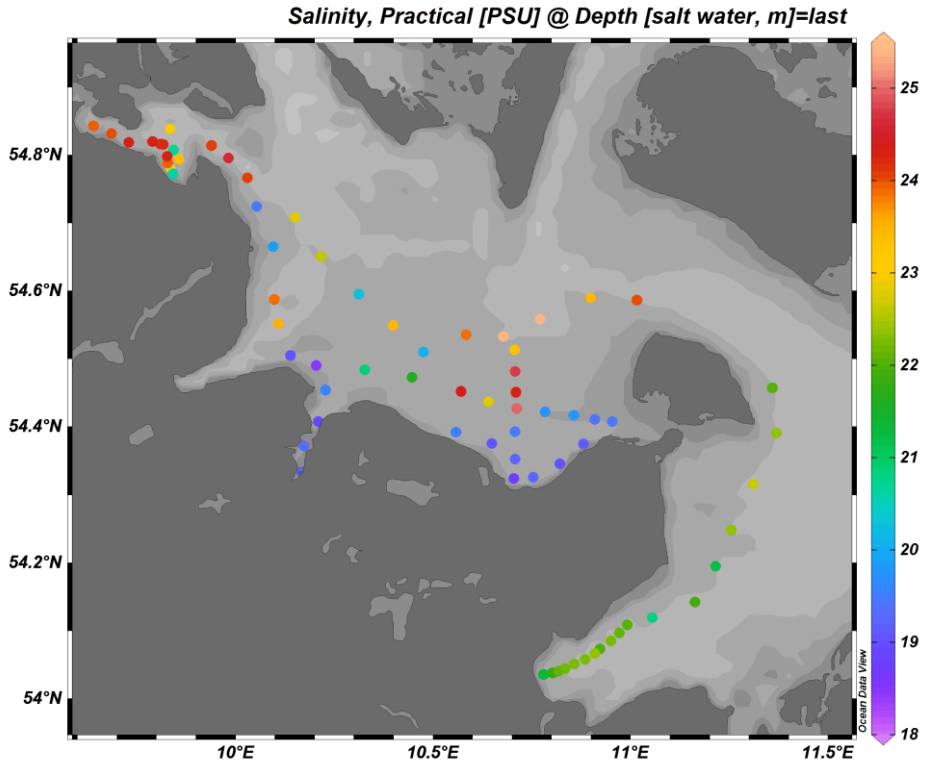

Figure 7: Salinity in deep waters along the cruise track.

We collect water from the Niskin bottles at 3-10 depths at each station for measurement of dissolved explosives compounds (Fig. 9). These include such chemicals as TNT (trinitrotoluene), and a number of other explosives and their degradation products. Because the Niskin bottles and CTD winch wire include some metal parts, they contaminate the water with metals, and cannot be used for trace element sampling. At a number of stations on this cruise, we instead use GoFlo bottles for ultraclean water sampling. These specialized bottles don't have metal components, and are deployed on a plastic-protected cable. In these samples, we will measure dissolved metals and metalloids including

lead and mercury, which were used extensively in primary explosives and are likely to be present at the munitions dumping grounds.

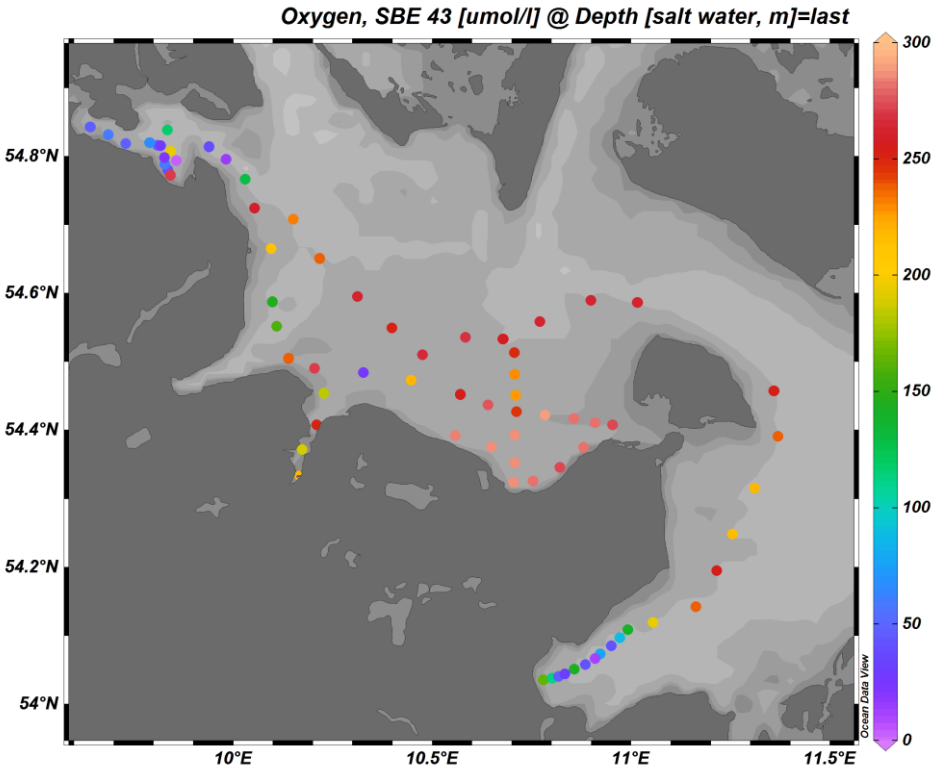

Figure 8: Dissolved oxygen in deep waters along the cruise track.

Figure 9: (Left) Collecting water from the CTD bottles for explosive analysis. (Right) Deploying GoFlo bottles for trace element sampling.

Within the remaining days in Lübeck Bay we will continue to explore the site with a sub-bottom profiler, ADCP, AUV and water sampling. Every one of the scientific crew is pretty excited about the incoming data, and theories about how to understand this region and its historical human impacts are constantly formed and discussed. So far we are fully on time with our planned research schedule and have even been able to do some extra work.

With many greetings from POS530,

Mareike Kampmeier on behalf of the scientific crew on board RV POSEIDON