

## Weekly Report POS530 MineMoni

1st – 7th October 2018



After WWII, munition was dumped into the Baltic and North Seas, and even after 70 years large amounts of munition still lie on and in the bottom of the seas. The BMBF funded project UDEMM, with partners from IOW, CAU and GEOMAR, is studying the environmental impact of conventional munition (those bombs that contain TNT and no chemical agents). The main working area is the Kolberger Heide, just 1.5h steaming from GEOMAR offshore Heidekate. Here, munitions loaded with explosives but without charges (!) were intentionally dumped after WWII to dispose of large munition stores on land. Similarly, munitions were dumped in the North Sea and other locations of the Baltic Sea. Furthermore, war activities of course also purposely deployed ground mines and sea mines to prevent ship traffic of the 'other side'. Remnants of these mines still rest on the seafloor 'somewhere'.

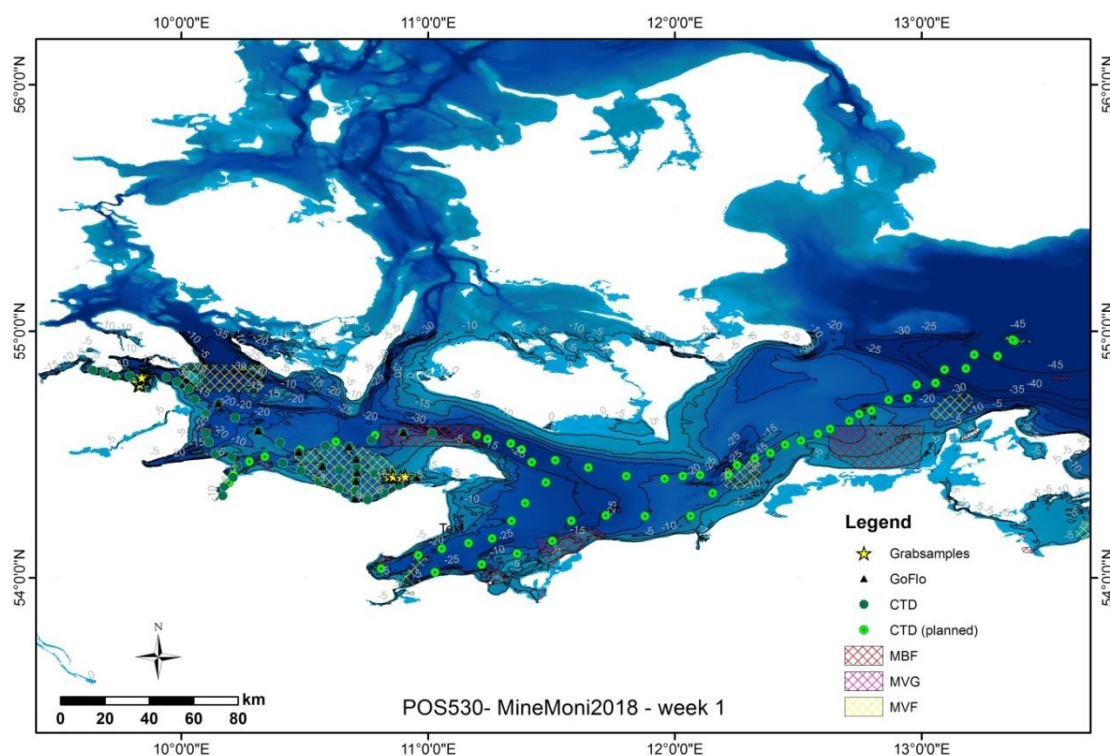


Figure 1: Overview map of the cruise track, with stations already done COLOR and those that will follow.

During cruise POS530 we are using state of the art equipment and newly developed analytical methods to see munition on the seafloor, detect trace amounts of TNT, TNT derivatives and other explosive compounds as mercury (part of the MuniSee project) in the water, and at the same time deploy mussels as bio-indicators of exposure to toxic explosive compounds. Logistically, the cruise was a bit of a challenge as scientific and technological personal needed to be changed and research divers of the CAU need to support our 'mussel-work'. The cruise is also used as training of the GEOMAR AUV team for running the still new AUV ANTON. Divers only need to be on board during the day and when dive operations have been thoroughly planned based on the new data. Further, we

use this cruise as a 'show case' for the two new Data Scientists employed in the large HGF project Digital Earth, as well as two colleagues of the GEOMAR Data Management Team, to see first-hand how the data they are working with are acquired and how operations at sea actually work. In short, many people have to come and go, including a film team from Radio Bremen. To make this happen, it was decided to NOT go into port every time we have to change personal, but to bring the personnel to the ship; boat shuttles were needed. Here the Ministry of Schleswig Holstein (MELUND) helped to organize boats from the Police and the THW for exchanges in Geltinger Bay, Heiligenhafen and Burg auf Fehmarn and in Neustadt in Lübeck Bay.

Our equipment consists of the 'ordinary' CTD for water sampling, a TV-guided CTD that is mainly used as underwater camera system, GoFlo bottles for mercury and metal free water collection, and a VanVeen grab for sediment sampling. We have a 300kHz ship-based ADCP for measuring water currents installed on the starboard side pole of RV POSEIDON. The same pole can be equipped with the underwater navigation system of the AUV (the USBL transponder) as well as an EdgeTech sub-bottom profiler which was borrowed from TIFFY (GEOMARs big AUV) to evaluate pulse length, frequency and power settings for upcoming cruises. AUV ANTON comes with two sensors, a small multibeam system and a new self-built camera system. Not completely state of the art but highly capable, the camera system consists of a GoPro camera and four GEOMAR-LED lights. The last piece of equipment is a high resolution T50 multibeam system installed in the moon pool of POSEIDON. The power of the system is its 512 very narrow beams of  $0.5^\circ$  by  $1^\circ$  beam opening angle with a resolution of 13cm in the centre of the swath and 52cm on the outer beams ( $60^\circ$  swath angle). This allows detecting small rocks and mines that lie on the seafloor, and further 'super-detailed' habitat maps can be produced showing ripple fields, pebbly seafloor and rocky-reefs next to more muddy sediment.

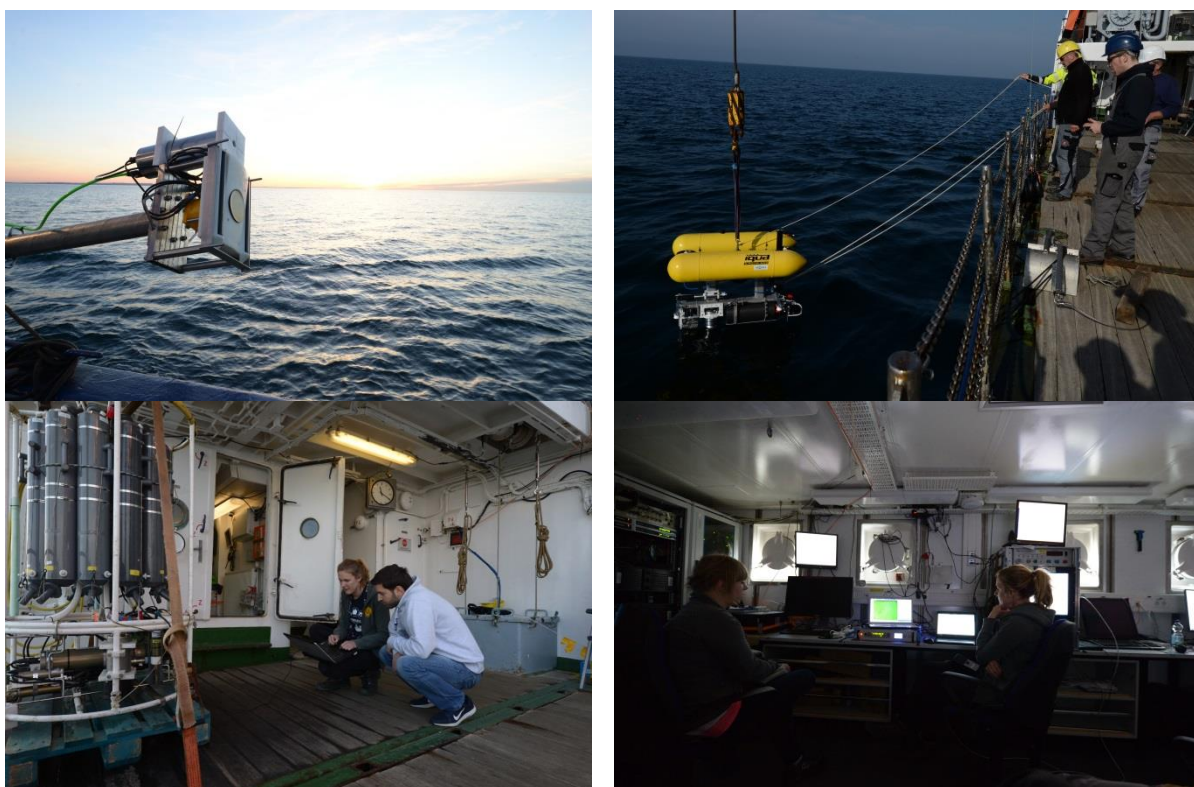
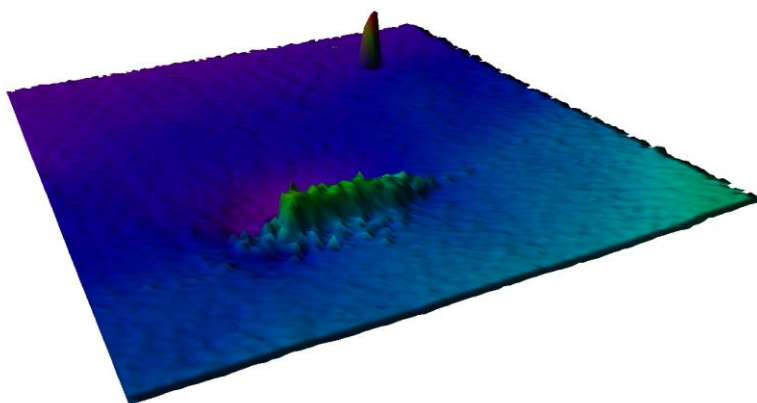


Figure 2: Cruise Impressions. TL Subbottom profiler during sunset; TR AUV Anton being deployed; BL Downloading image data from TV-CTD; BR looking at the seafloor during a TV-CTD camera tow.

With all this equipment, we finalized loading and installing on Monday 1<sup>st</sup> October at the GEOMAR pier and started the cruise at 16:00 in the afternoon. About 5 minutes later we had the first station at the entrance to the Schwentine River the first water sampling station of many to come. Figure 1 shows the stations taken by Sunday 7<sup>th</sup> and the planned CTD and GoFlo stations for the rest of the cruise. The CTD positions follow the so called 'Zwangswege' of WWII, routes that were used by the German Navy for ship traffic, but because of this they were bombed and mine barriers were put in place by Allied forces; in short, these Zwangswege most likely have the highest concentration of mines and bombs in the German Baltic Sea.



*Figure 3: 3D Visualisation of bathymetric data, showing a 3.58 m long object. Behind the objects a sediment scour have been formed. For biomonitoring purpose a mussel mooring has been installed by the divers in 7 m distance to the object.*

During the night of 1<sup>st</sup> to 2<sup>nd</sup> October, we sampled 13 CTD profiles between the Schwentine and Geltinger Bay in the north. Areas of potential munition dumps, more specifically the dumping of 167 V1 rockets, were partly mapped in the Geltinger Bay; two suspicious objects were identified to be later observed visually. Unfortunately the visibility at the respective water depth was very bad, hindering any clear view of the objects. Instead we performed a number of other visual tows, aiming at habitat studies and ground truth for multibeam based backscatter analyses. Backscatter here means the intensity of the hydro-acoustic signal of the multibeam which has been used for seafloor classification and habitat mapping in coastal and deeper areas. Ground truth data were acquired with a number of VanVeen grabs, and 9 additional CTD profiles were taken further inside the Flensburg Fjord. The first exchange of personal happened 4<sup>th</sup> October at 8am. Three people from Radio Bremen and four divers were transported by the 'Wasser und Schifffahrtspolizei' in Kappeln towards POSEIDON. The weather was brilliant and the sea totally calm. The divers deployed two moorings with small bags of mussels next to one of the suspicious objects, and interviews were given to the film crew. In the evening of the 4<sup>th</sup> CTD sampling recommenced on the way towards Fehmarn. After the last CTD station, multibeam mapping started within the Fehmarn Belt and later on in the Fehmarn Sund. Bathymetric data from the latter location showed a handful of objects on the seafloor resembling long, cylindrical artificial bodies, which may be ground mines.

It is virtually impossible to observe a small object on the seafloor using a ship towed camera system as wind and waves make it very difficult to manoeuvre the vessel with 1m accuracy. Thus AUV ANTON could prove that AUVs in such cases are much better suited to such fine scale tasks. Two photo transects with 1m line spacing and a photo interval of 2 sec and 1 sec acquired good data that will be used to generate a complete photo mosaic of the two areas (approx. 30m x 30m each). Both surveys successfully confirmed the existence of strongly overgrown cylindrical objects on the seafloor (Figure 5).

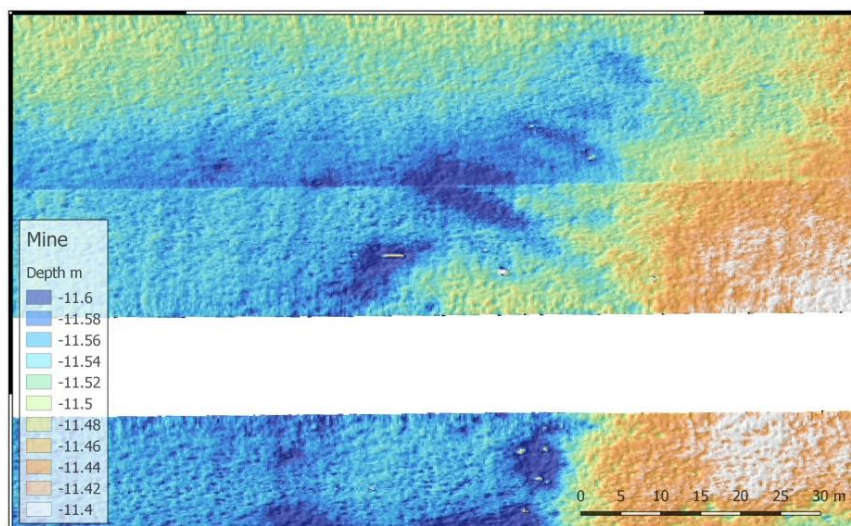


Figure 4: Bathymetric data showing a potential ground mine in a small depression. The overall depth range is only 20cm.

Gaps in the multibeam data set have been filled and right now (7<sup>th</sup> October at 1:40pm) we are on our way to the first grab sample station of today. Work will continue until 6pm with grab sampling, followed by another night of CTD and GoFlo casts and extending the multibeam map towards the north. Tomorrow AUV ANTON will investigate the seafloor again; during the previous night the wind picked up and waves are currently too high for a successful deployment of AUV ANTON.

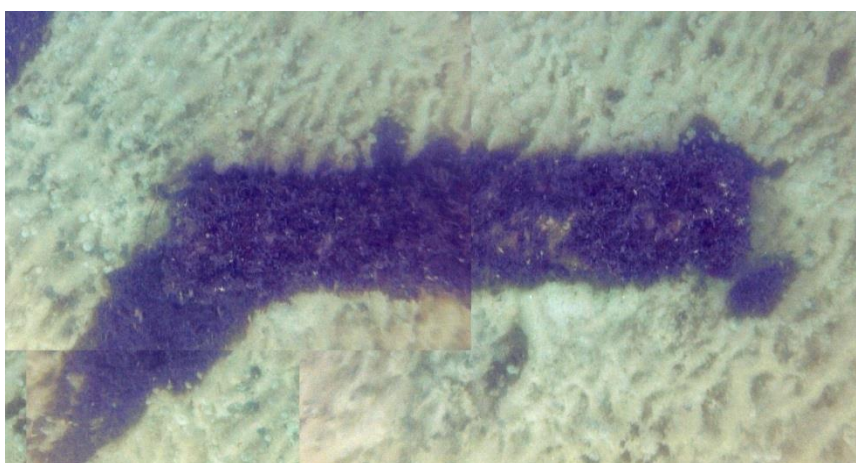


Figure 5: Cylindrical object in the Fehmarn Sund area. The object is about 2.5m by 0.6m in size.

On board everybody is well and got into the right working rhythm to acquire data that will for the first time show scientifically sound data of the environmental contamination of munition in the sea on large and small scales within the German Baltic Sea.

***With many greetings from POS530,***

***Jens Greinert on behalf of the scientific crew on board RV POSEIDON***