

Weekly Report AL548 (MineMoni II) #2

November 3 to 17, 2020

Scientific staff:

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Aim of the cruise:

Marine Munitions are a worldwide threat to marine safety and travel and construction but also to the environment as marine munitions release toxic substances into the environment. To study this impact, the UDEMM project (2016 – 2019) developed monitoring strategies for the mapping of munitions contaminated areas with hydroacoustic (multibeam), optical (towed camera and AUV-based) and geochemical methods (water sampling and onshore analyses) to collect information on potential contamination risks. Following the UDEMM project, two EU funded projects, BASTA and ExPlOTect (Dec 2019 – Nov 2022) are aiming at better, faster and more reliable munitions detection using high res multibeam combined with AUV-based optical and magnetic object verification and AI-supported predictions (BASTA; <https://www.basta-munition.eu/>) as well as sophisticated and unique near-real-time explosive compound analyses, using online preconcentration and direct injection into a mass spectrometer (ExPlOTect; <https://www.explotect.eu/>).

With cruise AL548 we continue the studies of UDEMM and particularly cruise POS530 (MineMoni I) from 2018. A CTD transect with water sampling for explosive compounds from Flensburg Fjord to Lübeck Bay is repeated and additional multibeam data are acquired in Kolberger Heide an Lübeck Bay. As new areas Falshöft, Kadetrinne and Trollegrund are surveyed with multibeam as well as AUV ANTON and AUV LUISE.

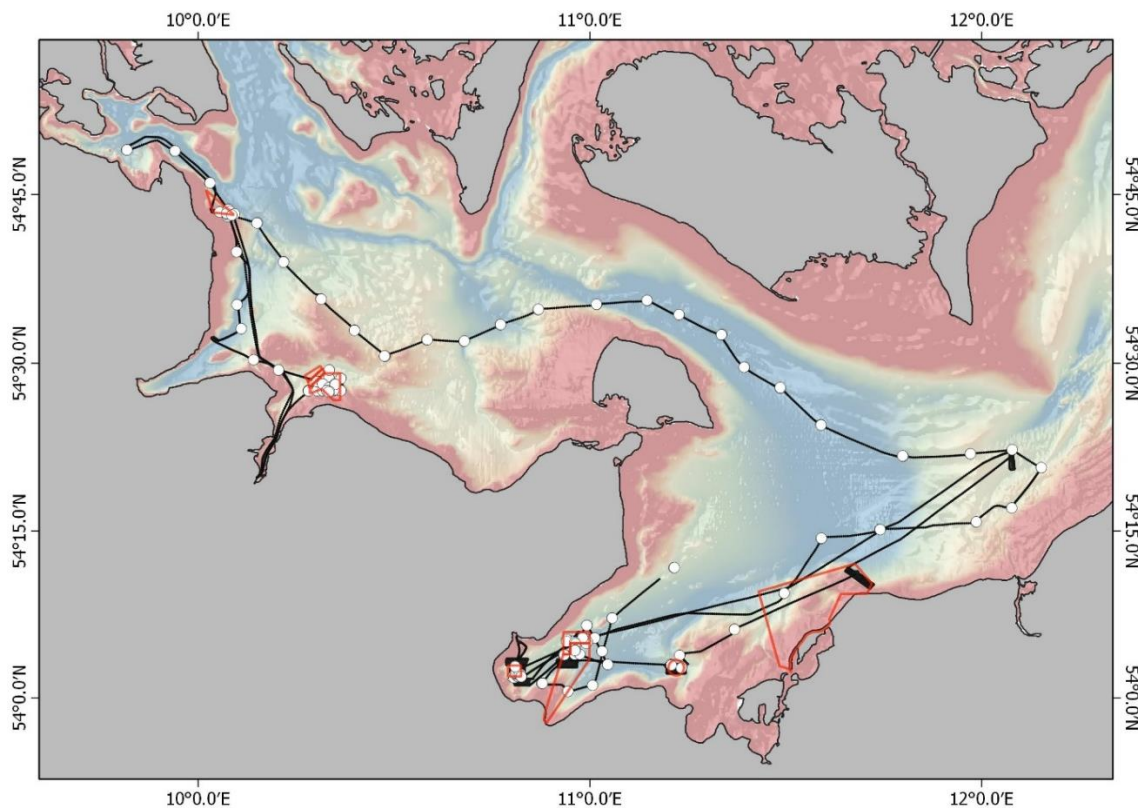


Figure 1: Overview over the cruise track of AL548. White dots indicate CTD stations that were taken by November 15, 6 p.m. Red polygons indicate munitions contaminated areas that were partially investigated during the cruise.

Week 1:

For information on week 1 of the cruise (November 3 to 8, 2020) please refer to report *Weekly Report – #1 AL548*.

Week 2 – Course of action:

Weekly Report #1 left of after the finalization of CTD measurements on November 8. Subsequently, the cruise continued in Lübeck Bay until November 13. Here, the workflow shown in Figure 2 was executed on a daily basis. Initially, multibeam mapping took place with the aim of identifying a number of targets that would warrant further inspection. Mapping happened during night to make the best use of the limited time. Once target points had been identified, some of these were selected and AUV ANTON (with camera) and AUV LUISE (with magnetic sensors and camera) were deployed to investigate them. AUV missions varied, sometimes investigating single objects, sometimes examining piles of objects. Magnetic data and images recorded by the AUVs were evaluated after they were brought on deck. Based on this data, target points were confirmed to either contain munitions items or not. While AUVs were performing their missions the video CTD was deployed to confirm another 16 larger target points (i.e. piles of objects). Furthermore, water samples were taken at another six CTD stations. In Lübeck Bay both known dump sites Haffkrug (BLB02L) and Pelzerhaken (BLB05L) are now fully mapped with a resolution of 0.5m and in some cases even 0.25m per grid cell. Many targets were confirmed. Next to these two dump sites, the area from Travemünde to the Pelzerhaken dumpsite was investigated as it was suspected to contain munitions from en-route dumping (BLB07L). This was confirmed and thus it would be reasonable to extend the Pelzerhaken dumpsite area to the south to cover all confirmed target points as well as those that show clear indications of munitions in the multibeam images. Finally, the area leading from Travemünde to the Haffkrug dumpsite was mapped with multibeam but it contained only a small number of potential targets. It is therefore reasonable to assume that no en-route dumping took place here and that the access route to the site originated in Neustadt (BLB06L).

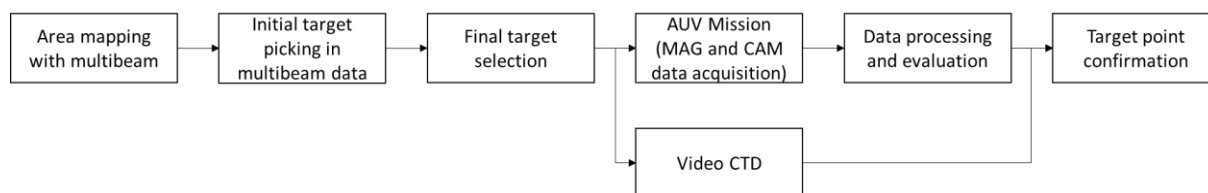


Figure 2: Workflow for munitions site investigation

In the night from November 13 to 14, a subsection of the Kadetrinne was mapped with multibeam. The rationale was that this area had been subjected to heavy mining (gardening) by the British Royal Air force during World War II. This investigation yielded only a single target point in almost six hours of mapping. Thus, the mapping was aborted and the area was left to continue mapping at the Trollegrund area. We were asked by representatives of the Ministry of Agriculture and the Environment of the State of Mecklenburg-Western Pomerania to perform investigations in that area. The reason for this: Munitions were once accidentally brought ashore from this area during coastal protection operations (dredging). The dredge area was within the impact area (BMB11L) of an anti-aircraft gun. An initial review of multibeam data yielded no hints that munitions would be present. Nonetheless AUV LUISE was deployed to a) perform some calibration measurements during which she run lines under the vessel in 15m water depth, but also to perform randomly selected profiles with camera and magnetometer close to the seafloor. Magnetic anomalies were detected and confirmed to be anti-aircraft munitions with images.

On November 14, mapping of the area Großklützhöved (BMB01L) was initiated. Reports indicated that barges were scuttled along with munitions. Three wrecks were found. One appears to be a sailing boat

but the other two appear to be barges. One of the two was capsized, with its content spread over a confined area roughly matching the hull size of the barge. Both barges were investigated on November 15 with video CTD and munitions contamination was confirmed.

After a return to Lübeck Bay, AUVs were deployed for another round of target confirmation. AUV ANTON inspected a number of targets that were picked from multibeam data recorded several days before. AUV LUISE inspected buried surrogate items that were intentionally placed there years ago.

We are now (evening of Monday 16th) already back close to Kiel and continue mapping of Kolberger Heide. As a quick summary, the cruise was very successful. With good weather, very good working equipment and a very motivated and professional crew, the cruise was exhausting but very productive. The current and last station, the multibeam mapping, is station number 160. With the hope that submitted proposals will be granted (among them a DAM proposal CONMAR) we hope to be back next year. The very good reconnaissance and inventory we made is a good base for more detailed, geochemical, toxicological and ecological studies in the future.

All members of the scientific and ships crew are well and are looking forward to some days of less work. With the best greetings from sea,

Mareike, Bene, Patrick, Torsten, Nikolaj, Marc and Jens

Highlights:

An area of roughly 24 km² was mapped with multibeam. We immediately started picking targets for the AUV missions and Video CTDs. However, the sheer number of objects (813 targets were picked in the Pelzerhaken area alone) makes it impossible to investigate all of them over the course of this research cruise.

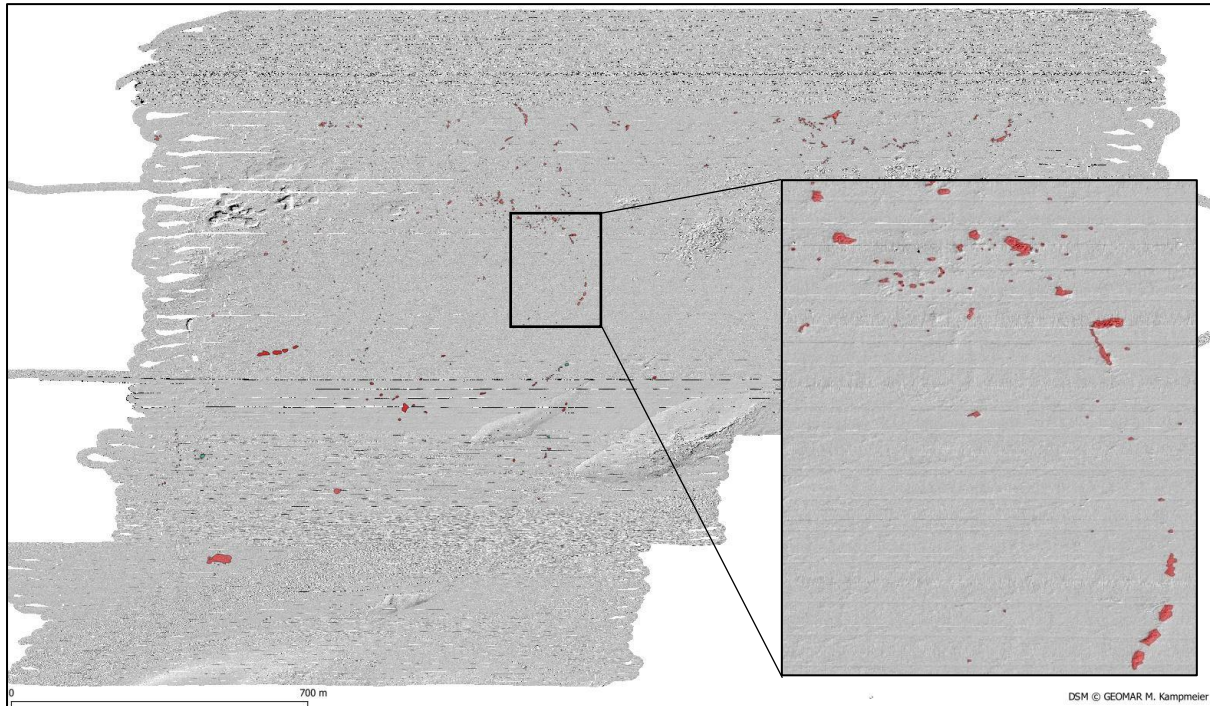


Figure 3: Overview of the area mapped in the dumpsite Pelzerhaken and the route from Travemünde to the dumpsite. Red polygons indicate picked targets. In this area alone we picked 813 targets, some of which were already confirmed to be munitions. Many of the targets contain numerous suspicious objects.

Since the beginning of the cruise an impressive amount of survey data were collected. The AUVs performed 38 missions (17 by AUV ANTON, 21 by AUV LUISE), many of which included investigating several targets. This resulted in a total number of 234,956 images. Figure 4 shows one of these images, which will be used to produce a target list.



Figure 4: Boxes filled with munitions that were photographed by the camera of AUV Anton.

The AUV mission in Trollegrund was executed on randomly selected profiles (Figure 5) and still two anti-aircraft shells were certainly confirmed (6) and two additional suspicious objects were found. This means that we were either incredibly lucky to find these in the limited amount of time that was spend in the area, or (more probably) that the entire area is generally contaminated.

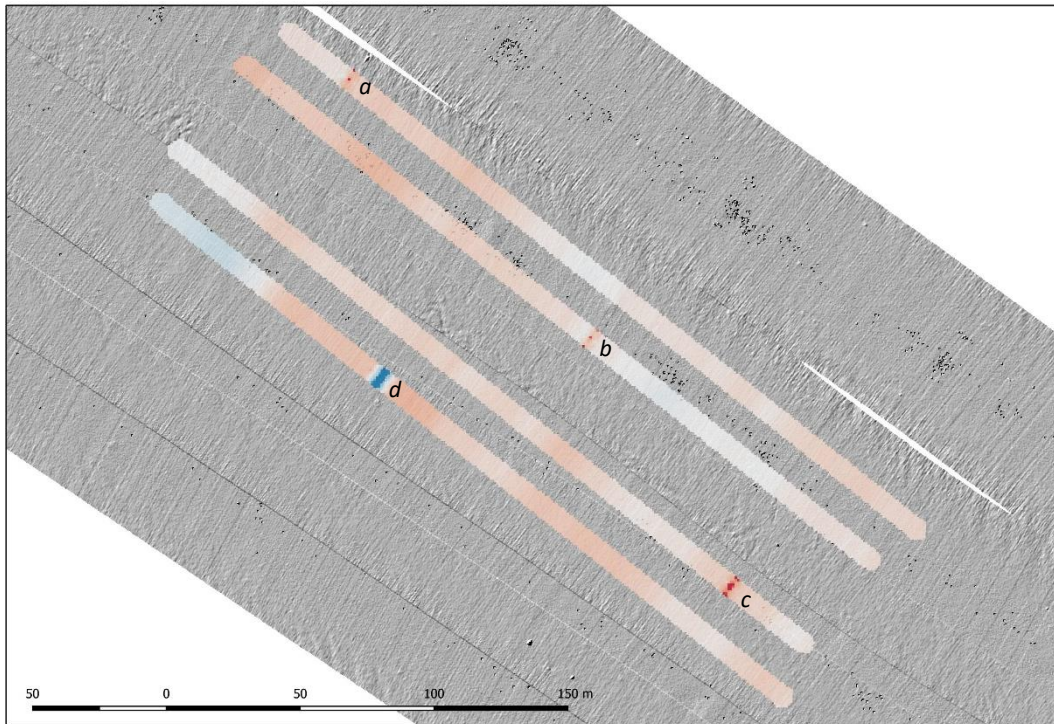


Figure 5: Randomly selected magnetic profiles at Trollegrund. Magnetic anomalies (a, b, c, d) are clearly visible.

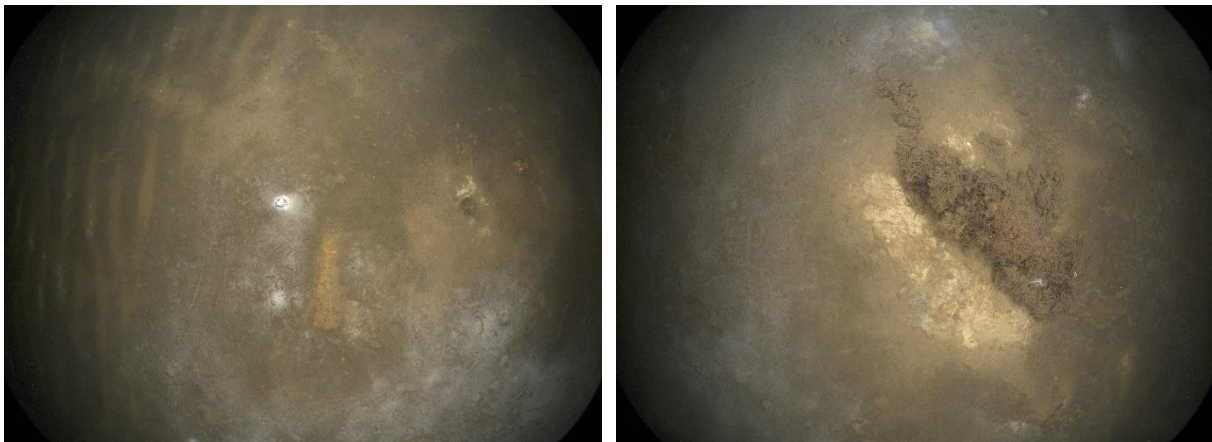


Figure 6: Images of anti-aircraft shells, that were found on at locations of anomalies a (left) and b (right) (see Figure 5) of the Trollegrund AUV mission. These objects are probably randomly distributed in the munitions contaminated area BMB11L.

Two barge wrecks were found in the Großklützhöved area. Since it was not possible to perform mapping of the entire area, it is possible that additional wrecks are present. Figure 7 shows a high resolution multibeam image of one wreck (Wreck Mareike) and its cargo that was probably spilled, when it capsized. It became clear that the area was/is a dumpsite for other substances, as a large amount of dumped material is present.

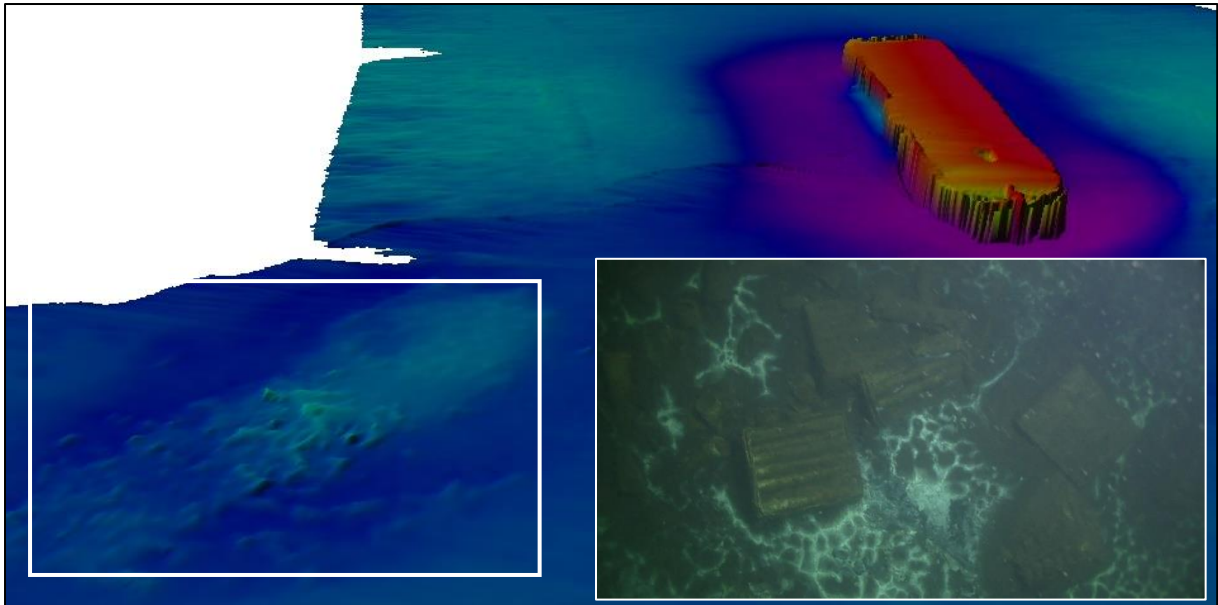


Figure 7: High resolution multibeam image of the capsized wreck. The smaller image shows a screenshot taken from the video CTD, proving that the spilled cargo is munitions.