# Research Vessel SONNE

SO278: 12.10. – 01.12.2020
Emden – Emden

## 3rd Weekly Report: 26 Oct. – 1 Nov., 2020

The first dive of the AUV (Autonomous Underwater Vehicle) SEAL 5000 on Sunday, 25 October was watched with excitement by everyone on board. After the vehicle had taken its place on the ship again after its mission (Fig. 1) and the data could be downloaded, we knew that everything had gone well and the AUV team could relax. Our bathymetry group went to work immediately and converted the data into a high-resolution bathymetric map and a map of the backscatter values. We were all amazed about the accuracy with which the morphological structures of the Bergamo mud volcano suddenly lay in front of us and how they, of course, immediately aroused requests for sampling. First, however, an observation profile with the on-board video sled (OFOS) over the mud volcano, which we carried out on Monday, 26 October, was supposed to clarify individual structures. The dive with the OFOS began on the plateau-like central elevation of the mud volcano. Based on the flow structures two outflow areas are visible and according areas of high backscatter provide evidence for extensive eastward flow from the eastern, younger outflow area (several hundred meters). In the central area of the mud volcano we saw typical mud breccias with many clasts of solid rock of various sizes in the OFOS video. Cracks in the mud caused by the movement of the mud flows often show gray colors, typical for reduced geochemical environments on their flanks, while the surface sediments are characterized by brownish colors common in oxygen-rich environments. Isolated tube worms and numerous shells of lucinid clams are evidence of chemosynthetic fauna that only occurs scattered about, and, hence, does not mark a center for fluid or gas outflow on the volcano.

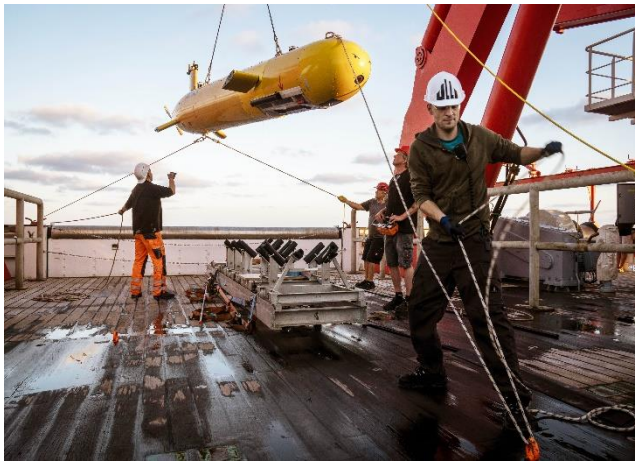

**Figure 1:** Ship's crew and scientists during recovery of MARUM AUV SEAL 5000 after its first deployment on the Bergamo mud volcano (© Heike Duggen).

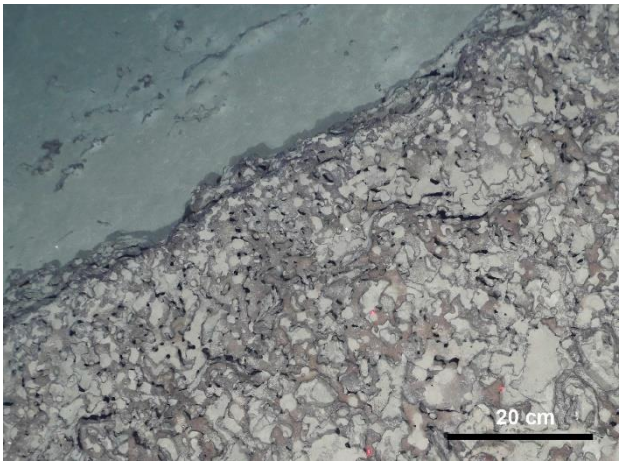


**Figure 2:** OFOS photo of a thick carbonate layer with a bioturbation structure on the ocean floor from the upper edge of a crater structure associated with Bergamo mud volcano.

Along the OFOS track, in a south-westerly direction, the western slope of the mud volcano went 80 m downhill, where several round craters with a diameter of 100-150 m and a depth of 20-40 m occurred, which appeared interesting not only because of their very low backscatter values. Extremely high backscatter values on the other hand exist around the edges of the craters and can be explained by the occurrence of strongly lithified sediments, while a selective carbonate precipitation seems to exist along traces of bioturbation (Fig. 2). After the nightly mapping activity to the north, we took sediment cores of the Bergamo and Napoli mud

volcanoes on Tuesday, 26 October, from which we are primarily interested in the pore water profiles. The Napoli mud volcano has increasing salt content with depth, which shows that the pore water is influenced by the Messinian salts occurring in the sediments below, while the pore water of the Bergamo mud volcano shows decreasing salinity to values of 10 ‰ in half a meter below seafloor, which indicates fluids from great depth.

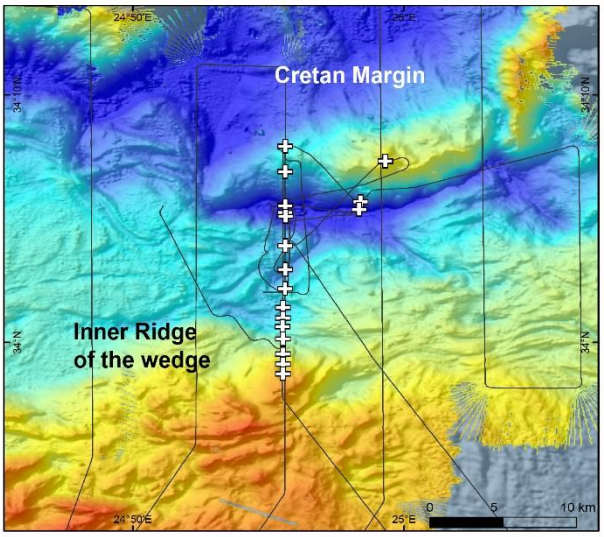


**Figure 3:** Sea floor map after surveying with the EM122 multi-beam echo sounder in our main area in the transition from the accretionary wedge (below) to the continental margin of Crete (above).

**Figure 4**: Scientists with happy faces in the main gate to the hangar of RV SONNE, waiting for the next sediment core to come on deck (© Gerhard Bohrmann).

Since Wednesday, 28 October, we have been carrying out station work approximately 20 nautical miles north of the Olympi mud volcanic field in the so-called zone of the Inner Ridge (Fig. 3). The Inner Ridge is laying between the actual accretionary wedge of the collision zone between Africa and Europe and the backstop of the continental margin of Crete in the north (Fig. 3). Since no increased methane concentrations were found in the water samples of the CTD stations carried out so far, which normally give indication of fluid and gas emissions, we rely on morphological evidence as well as on backscatter anomalies of the multi-beam measurements on our search for seepage. Since Wednesday we have also carried out 2 AUV measurements and 2 heat flow profiles at specifically selected locations, and have taken 6 gravity cores and 4 multicores.

From Wednesday evening, the wind increased for the first time to Beaufort wind strengths of 6 and gusts of up to 7, with a swell from west to northwest causing waves up to 3.5 m high. As a result, we had to postpone an AUV dive and mapped the region of the United Nation's ridge in the night from Thursday, 29 October to Friday with the ship’s hydroacoustic systems instead. The weather already got better on Friday, although we had some rain with medium cloud cover. On Reformation day, Saturday, 31 October, a profile measurement of a section along the Inner Ridge was carried out during the night with the heat flow probe, after several core stations were completed during the day. This morning, the AUV dove to a depth of 3,500 m for mapping and will only return to the ship with its measurement data shortly before it gets dark. Today we had not only sunny weather with almost cloudless skies, but also extremely clear views. Although our distance to Crete is around 50 nautical miles, we could see the edge of the island from the ship today.

All participants are healthy!

Best regards also on behalf of the cruise participants,

Gerhard Bohrmann (Marum, University of Bremen) R/V SONNE, Sunday 1 November 2020