Research vessel
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MSM131: 18.08. – 28.09.2024
Reykjavik - Emden

Sixth weekly report: 16 - 22 Sept. 2024

Despite its shortness, the sixth week was the most successful for our science. It was only 4 days long for our work, because on Thursday evening we stopped station work and set off on the return journey to Germany. Due to significantly better weather conditions than in the previous week, we were able to dive on 3 out of 4 days. Only Tuesday, 17 September, did we not have the opportunity to use our diving robot due to the high swell and a strong wind of Beaufort 6-7. During that day, the surface sampling program in the Jøtul hydrothermal field and the area of the hydrothermal plume to the north was completed with 3 mini-corer stations. With a total of 35 stations, a great set of samples was obtained on our crruise, the analysis of which will show an image of the drift of hydrothermal particles through the plume.
The three dives of the week mainly worked on profiles that began in the west at a water depth of more than 3000 m and examined the sea floor up the slope to the east. The almost daily growth changes on the two smokers of the Jøtul main field Gyme and Feneris were usually at the beginning of the investigation programs. During the two dives 488 and 490 (Fig. 1 and 2) we examined a sea area at a water depth of 2935 m that contained numerous indications of cold seep outlets. Using a new camera system that is aligned vertically to the bottom and records high-resolution digital images below the ROV every half second, we mapped an area of around 600 square meters. The ROV flew over 25 lines at a distance of 1 meter so that a high degree of coverage of the image series was achieved and an overall mosaic of all images could be calculated on board. Without having carried out a precise habitat characterization, we were able to identify certain patterns. The most striking were areas with yellowish-brown crumbly crusts, which contained significantly more faunal components than other surfaces. Other areas were covered by gray bacterial mats, while the largest areas were covered by clay-brown seafloor with the occasional visible of tubeworms.

Figure 1: View into the pilot control room of MARUM ROV QUEST4000. From this fully equipped control container, the two pilots have control of all video cameras and steer the vehicle on the seabed (© Gerhard Bohrmann).

Figure 2: ROV QUEST4000 is back from its second-to-last dive on this cruise from the Knipovich Ridge in 3000 m water depth and is lashed by the crew on the aft deck under the A-frame of the ship (© Gerhard Bohrmann).

To characterize these surface areas, we took two push cores each and carried out a measurement in the respective habitat with the temperature lance. The temperature lance has 8 temperature sensors that are lined up at a distance of 8 cm. The temperature profile or temperature gradient is then determined using the 8 measurements, which last for about 12-15 minutes. Under visual control of the cameras, the ROV pilots place the push cores and the T-lance, thus ensuring that samples and measurements are taken in the same habitat (Fig. 4). After the dive, the push cores were immediately sampled on board for pore water and gas composition and partially analyzed. High methane contents with a characteristic distribution in the cores showed that methane dissolved in the pore water is involved in different microbiological processes that depend on the habitat. In addition to anaerobic methane oxidation, other processes such as fluid flow from the subsurface and biological activity of benthic macro-organisms play a role. For a more precise interpretation, however, the pore water profiles of inorganic components are important, but these can only be determined in the laboratory in Bremen. The big question we ask ourselves when interpreting this seep area is the question of the driving process. Is the hydrothermal circulation of the Jøtul field the driving mechanism and are we dealing with a cold end of a circulation cell, or do other mechanisms such as dewatering of marine sediments play a role that have no direct connection to the hydrothermal circulation? The origin of the methane is very important to determine, which we want to clarify with the isotope analyses of carbon and hydrogen in the home laboratory.

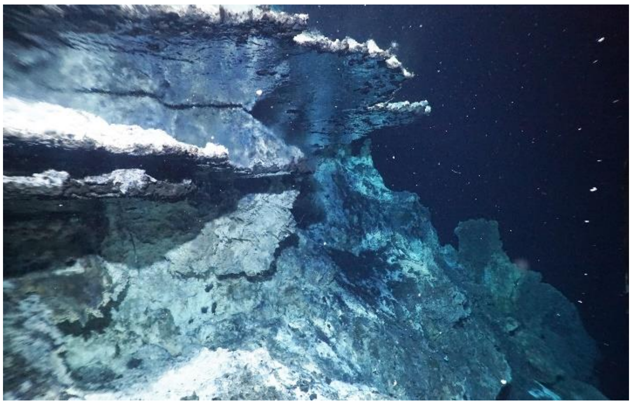

Figure 3: Hydrothermally formed rock formation on the summit of Yggdrasil Hill. The rock-forming minerals precipitated from the 280°C hot fluids build up horizontal flanges on Yggdrasil under which the hot escaping water is reflected (© MARUM).

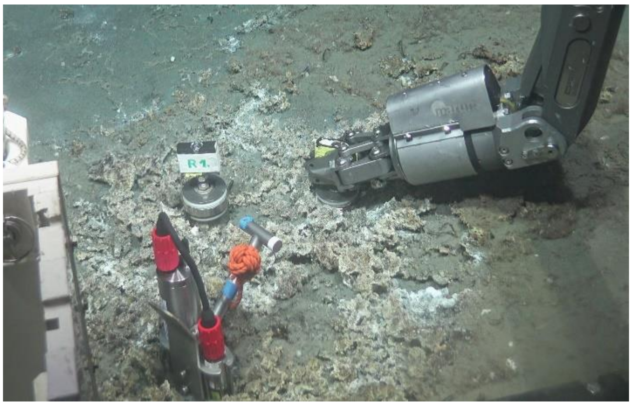

Figure 4: ROV work with the QUEST manipulator arm on the seabed at a water depth of 2950 m. While the T-lance (left of the extended drawer) measures the temperature at 8 sediment depths, the arm places 2 push cores in the same seep area (© MARUM).

We investigated a completely different question on the penultimate dive 489 by examining and sampling an oceanic core complex (OCC) that is located immediately east of the Jøtul hydrothermal field and whose relationship to the hydrothermal field is completely unclear. Rock complexes of an OCC consist largely of ultra-basic mantle rocks that are serpentinized and rise up through intensive interaction with seawater at deep faults. Such faults in the rock structure are often recognized on the surface of OCCs by a striped pattern in the detailed morphology. A detailed survey with an autonomous underwater vehicle (AUV) two years ago discovered such a micro-bathymetric striped pattern, so we can assume that an oceanic core complex is present here. During dive 489 we selectively collected 14 different rock samples from the sea floor along a 600 m long profile and the petrographic analyses in the Bremen laboratories will give us information about the rock diversity and its relationship to the OCC.

A final report of the expedition will be available next week.
All participants are healthy.
Greetings on behalf of all participants,

Gerhard Bohrmann RV MARIA S. MERIAN, Sunday 22 September, 2024