Research Vessel
MARIA S. MERIAN

MSM109: 06.07. – 03.08.2022
Tromsø – Reykjavik

3rd Weekly report: 18. – 24.07.2022

Our 3rd week was the most successful week so far, because for the first time we were not only able to document but also measure hydrothermal vents at the Knipovich ridge. Also, the technical problems of AUV and ROV have been overcome. But first things first: As mentioned in last week's report, during last Sunday's dive we discovered patchy areas of tubeworms and microbial filaments that gave us the first indications of active fluid outflows in an area of the eastern rim of the graben. To further explore this prospective area, an AUV dive was conducted during the night and a CTD station in the morning to measure methane distribution. The following Monday we steamed north into the Fram Strait between Greenland and Svalbard to conduct investigations at the Molloy spreading center. The two weeks before, this area was covered with pack ice, which drifted from the Arctic Ocean into the East Greenland Current via the Transpolar Drift and prevented station work there on the Molloy ridge. The RV MARIA S. MERIAN with its ice class PC7 does not have to fear sea ice, but the operations with our ROV and AUV deep-sea vessels require ice-free water. Therefore, it was necessary to know the ice situation over the Molloy ridge. The team at the AWI sea ice portal only calculated a 5 percent probability of sea cover over the Molloy Ridge for the last 15 years, but the strongly fluctuating ice cover in July made it necessary to assess the ice situation on a daily basis. We also received the information daily in the form of current satellite data via the sea ice portal of the Bremerhaven colleagues. The ice situation allowed us to do all our surveys, station work and dives from Monday to Wednesday. The sea was extremely calm, there was partly bright sunshine (Fig. 1), with otherwise very foggy conditions (Fig. 3). Wednesday was special, when we were able to observe a fog bow (Fig. 2) in several variations from the ship during the day. Similar to a rainbow, a fogbow is formed by reflecting sunlight with a fog front, with the reflecting water droplets being extremely small at 5 microns.

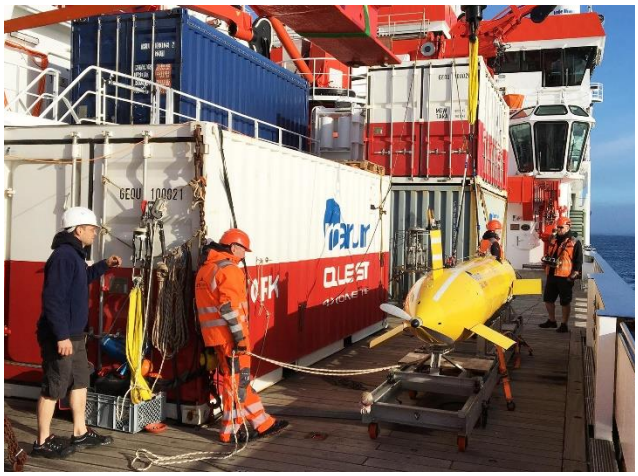

Figure 1: The AUV MARUM SEAL 5000 on the deck of R/V MARIA S. MERIAN before its third mission in sunny weather in the Fram Strait (@ Gerhard Bohrmann).

Figure 2: Fine fog and sunshine on Wednesday, 20 July near the ice edge in the Fram Strait resulted in multiple atmospheric fog bow phenomena (© G. Bohrmann).

Midweek we steamed out of the Fram Strait back to the Axial Volcanic Ridge (AVR) at 77° 20'N. To distinguish this AVR from the AVR further south near the Logachev Seamount we use the name of Waldemar Christofer Brøgger, a Norwegian geologist who has become internationally famous not only for his work on the igneous rocks of the Oslo Graben. At the geographical latitude of the now named Brøgger AVR, we have the best chance of finding and documenting hydrothermal activities of the Knipovich ridge at the eastern edge of the

graben thanks to our Eh and methane anomalies and our first observations from a dive. Therefore, during two AUV dives, we added further micro-bathymetry to an earlier AUV map of the Norwegian Petroleum Directorate in order to get as much preliminary information as possible on the morphological phenomena for the diving work with the ROV. We are measuring a last missing bathymetry area on the seabed of this region this Sunday night. We focus on a north-south band at a water depth of 3,000 m in the foot area of the eastern rim of the graben, which is characterized by a further subsidence of the seabed to the west up to the Brøgger AVR to about 3,500 m.

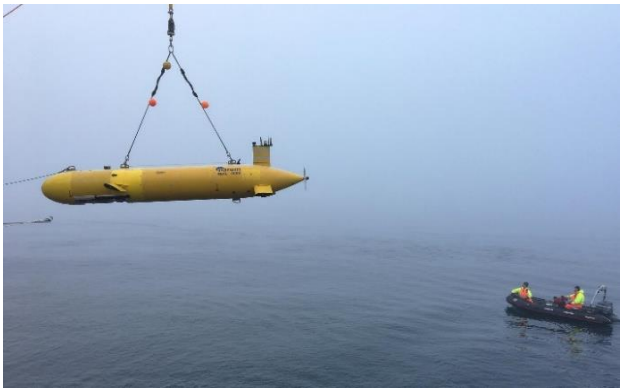

Figure 3: After a long dive, the AUV SEAL 5000 is recovered in the morning. The sea is completely calm here in the Fram Strait near the ice edge and, despite the dense fog, it makes it easier to recover with the rubber boat (@ Gerhard Bohrmann).

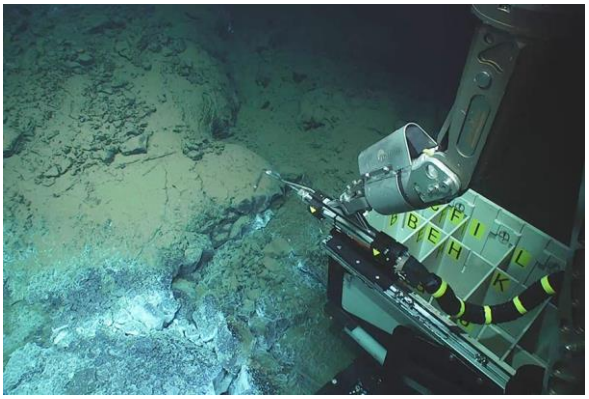

Figure 4: Fluid sampling from a hydrothermal vent at a water depth of 3,000 m at the edge of a lava cover. The exit of 8°C warm fluid is characterized by microbial growth and white precipitates (ROV QUEST dive 461).

The AUV map shows that igneous rock bodies are also present in the deepest part, extending to the foot of the eastern graben depression. During the ROV dives on Friday and Saturday, we repeatedly observed outflows from pillow lavas that formerly flowed onto a sedimentary bedrock. Some rift-parallel fissures at a water depth of about 3,000 m also show on the fissure walls that pillow basalt layers stacked on top of each other contribute to the structure of the lower slope area of the rift wall. During the dives we repeatedly found indicators of hydrothermal venting in an approximately 50-70 m wide strip parallel to the slope. These can usually be recognized by white staining (Fig. 4), which can be traced from the lower edges of the rock in a vertical direction on the surface of rocks. On closer inspection, tubeworms cloaked in filaments of bacteria can always be found in the area. Very small gastropods and crabs, a few millimeters in size, can usually be seen. Fluid samples showed that methane concentrations of several 100 nmol/L are present there. During yesterday's dive we sampled an exit site with shimmering fluid that was 8°C and mixed with bottom water at -0.6°C (Fig. 4). The methane level rose to almost 2 µmol/L and had a distinct H_2S odor after recovery. The corresponding chemosynthetic organisms and precipitates from the location were recovered and are being investigated within the Bremen Cluster of Excellence. During the dive we were also able to recover sulphide precipitates and parts of a chimney which was mainly gypsum. The sampled region appears to be characterized by widespread diffuse venting, which explains the high methane concentrations we measured in the CTD water samples.

All participants on the ship are healthy.

Greetings on behalf of all participants

Gerhard Bohrmann FS MARIA S. MERIAN, Sunday 24 July 20122