

Research Vessel

MARIA S. MERIAN

MSM109: 06.07. – 03.08.2022

Tromsø – Reykjavik

2nd weekly report: 11. – 17.07.2022



In the second week of our expedition we carried out surveys in the northern part of the Knipovich Ridge west of Spitsbergen (Fig. 1) to find hydrothermal activity. During the first ROV QUEST dive (Fig. 2) on 10 July, we explored a seafloor region at the southern end of the Axial Volcanic Ridge (AVR) at 77°24'N latitude. There, an Eh anomaly in the water column about 70 m above the sea floor was measured with an AUV during the expedition of the Norwegian Petroleum Directorate last year. The goals of this dive were to find an explanation for this anomaly on the sea floor, but at the same time to understand the bottom composition of the AVR. Unfortunately, the dive had to be canceled earlier than planned for technical reasons. We did not find reasons for last year's Eh anomaly, but we were able to gain important geological insights. Volcanic rocks form the approximately 20 km long and more than 500 m high AVR in the middle of the 3,500 m deep central graben of the Knipovich ridge. The basalts we found at this AVR occur in the form of solidified tubular pillow lavas, which are covered with a relatively large amount of hemipelagic sediment (Fig. 3). Despite the sedimentary cover, very characteristic elements of the pillow basalts can be seen, such as volcanic glass at the outer edge of the pillows and shrinkage cracks caused by the cooling of hot lava in cold sea water. We specifically collected corresponding rock samples from the seabed.

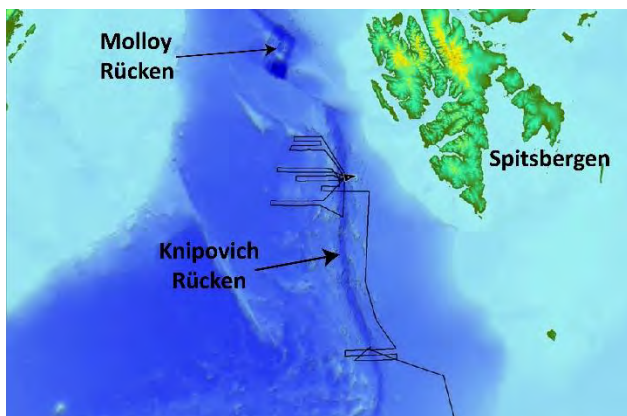


Figure 1: Map of the Nordic Sea between Greenland and Spitsbergen. Knipovich and Molloy ridges are forming the spreading center of the tectonic plates. Black lines = survey profiles of the MARIA S. MERIAN west and east of the ridge.



Figure 2: Deploying the MARUM ROV QUEST from the aft deck of the RV MARIA S-MERIAN in the early morning with changing weather conditions (© Gerhard Bohrmann).

During a second longer dive with MARUM ROV QUEST on Tuesday 12 July in this area we were able to investigate a larger area. The pillow basalts form numerous mounds of about 20-40 m in height and 200-300 m in diameter, the areas between the mounds are completely covered with sediment. These hill structures, which are widespread on the AVR, had already been noticed in the high-resolution bathymetric maps of the Norwegian AUV survey, whereby the formation of the hill structures from the dives is now better understood.

A second very prominent axial volcanic ridge (AVR), lies close to the Logachev Seamount, about 50 nautical miles south of the previously studied AVR in whose extension an apparently young volcanic area appears morphologically. It is mainly characterized by very high backscatter values in the side-scan sonar and backscatter recordings of the AUV multi-beam survey. We were able to understand that relatively young

volcanic activity prevails there during a very extensive ROV dive on Wednesday, 13 July. In contrast to the previously examined AVR, there is significant less sediment cover and an unexpectedly large variety of cooled volcanic lava rocks were found on the sea floor. In addition to pillow lavas that are already known, we can also distinguish between ropy lavas and flat and smooth former lava flows, which we also sampled individually. In addition, there were deposits of very rough, sharp-edged lava fragments, which indicate lava that was formerly very gas-rich and are referred to as 'a'a' lava at Hawaii. Here, a hill structure 50 m high and 500 m in diameter was built up by these magmatic rocks, which, however, showed huge cracks and fissures of several meters deep in the direction of the spreading. In one such fissure we found for the first time hydrothermal precipitates in the form of rock staining and small sulfide smokers (Fig. 4). Due to technical problems with the ROV, we were no longer able to investigate whether there was still low thermal activity. Unfortunately, the technical problems of the ROV continued until the end of the week and it was not until this Sunday, 17 July, that we are back on the seabed with the ROV.

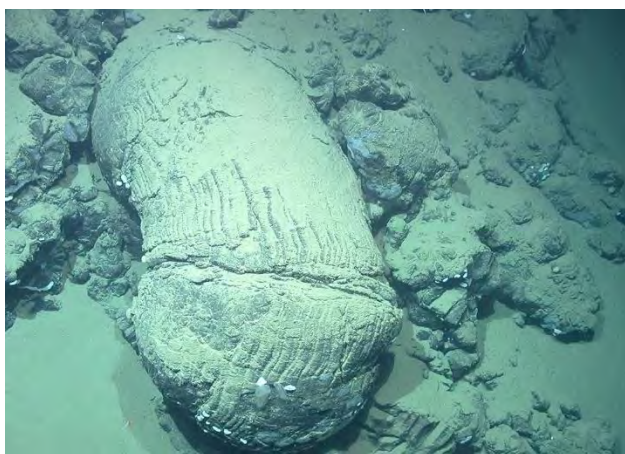


Figure 3: Crystallized and lightly sediment-covered tubular basaltic lava at the edge of a pillow lava mountain of the Northern Axial Volcanic Ridge (AVR) in the Knipovich graben (ROV QUEST dive 455).

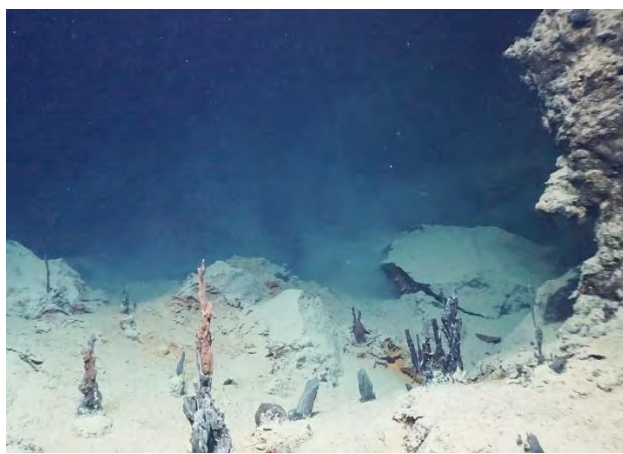


Figure 4: Hydrothermal field with 30-50 cm high sulfide smoker precipitates in an open fissure of the young volcanic area north of the Axial Volcanic Ridge NE of the Logachev Seamount (ROV QUEST dive 457).

With the AUV, we carried out micro-bathymetric measurements in the area of slide complex on Tuesday and Thursday night. Here, we were guided by an earlier measurement of the redox potential in the water column too, which we were able to confirm during a CTD measurement with an Eh sensor. In the meantime, this region has proven particularly attractive to continue searching for hydrothermal activity as we have detected Eh anomalies and small temperature anomalies in several Yoyo CTD profiles. In addition, the water samples with levels of 100-1,000 nmol/L have high methane concentrations with otherwise background levels of 2-4 nmol/L. Unfortunately, there were technical issues with both the AUV and ROV in the second half of the week, so we used the ship time for other work. The focus was on surveying with the ship's own multibeam, especially of the western shoulder of the Knipovich graben together with the CTD measurements. On Saturday evening both diving vehicles, AUV and ROV, were operational, but the weather was blowing too hard with Beaufort 7 winds. The sea only calmed down again this Sunday and we are back on the seabed in the area of the slide complex with the QUEST diving robot. So far, we have found a large number of white bacterial mats there, mostly at the edges of individual pillow layers, which indicate diffuse escape of fluids. We will report on further progress of our work next week.

All participants on the ship are healthy.

Greetings on behalf of all participants

Gerhard Bohrmann

FS MARIA S. MERIAN, Sunday 17 July 20122