Research Vessel MARIA S. MERIAN

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After completion of seven drill sites with MeBo at the continental margin of Svalbard at the landward edge of the gas hydrate stability zone within water depths of around 400 m, we started a new drilling site well within the gas hydrate stability zone in around 445 m water depth. Pressure, temperature, as well as gas compositions are the major factors controlling gas hydrate stability, and at this water depth of 445m we are well within the methane hydrate stability field. The various drill sites, completed to a maximum depth of 38 m below seafloor during three days from Monday to Wednesday did not, however, yield any evidence for the presence of gas hydrates. Not all sub-samples have been fully analyzed yet, but the hypothesis that widespread occurrences of methane hydrate along the Svalbard continental margin did melt in response to the 1°C warming scenario in water depths shallower than 400 m (and are the reason for the numerous gas emissions seen emanating at the seafloor) appears unlikely based on our initial onboard results.

After a short mapping survey (Fig. 1), MeBo was again deployed Wednesday evening to start a new drill site in 340 m water depths, well outside the methane hydrate stability zone. Drilling lasted until Thursday morning reaching a depth of 22m. The cores revealed an interesting sequence of glacial deposits. Pore-water and gas-compositions measured from this site (Fig. 2) outside the hydrate stability zone are an important constraint to better understand our previous results and establish a regional picture of the potential hydrate occurrences along the margin. An additional gravity core was taken at the same location, with a recovery of only 1 m, but allowing careful sub-sampling of the sediments closest to the seafloor. Due to a change in the weather making further drilling too challenging, we left the shallow water margin sites to start a mapping program across the Knipovich Rift further to the South.

Figure 1: All the various data sets are collected and monitored in the hydro-acoustic lab onboard of MARIA S. MERIAN. Scientists are thus able to immediately display and interpret the data.

Figure 2: Inside the large hangar onboard MARIA S. MERIAN, all sediment cores are described, and sub-sampled for pore water and gas analyses.

The Knipovich rift zone is a graben-like depression, cut by the Molloy transform-fault in the North. About 60 km further west, the rift-zone continues as the Molloy rift zone further into the Arctic Ocean. Along a 120 km long profile we set out to map the eastern rim of the spreading centre of the Knipovich rift system from North to South.

Weather conditions had turned drastically throughout the day. While previously, winds have been mostly from the South to Southwest, we now face strong northerly winds. Air temperatures dropped suddenly by 6°C to near the freezing point, accompanied by a snow-storm (Figure 3). Initially, with the winds in our back, the mapping proceeded well despite the decrease in overall weather conditions. However, at the southern end of the profile and after a change in course of the MARIA S. MERIAN to a more northerly direction, the conditions worsened. The third engine was added to maintain a speed of 10 knots against the strong winds, which was successful initially. With wind speed up to 22 m/s (Beaufort scale 9), however, the vessel became steadily slower, as swell increased considerably. Accordingly, many people did not feel too well and many exhausted figures were seen in the morning.

Figure 3: A shift in weather pattern on Thursday with high winds from the Arctic Ocean resulted in a drop in temperature by 6 °C, accompanied by snow fall.

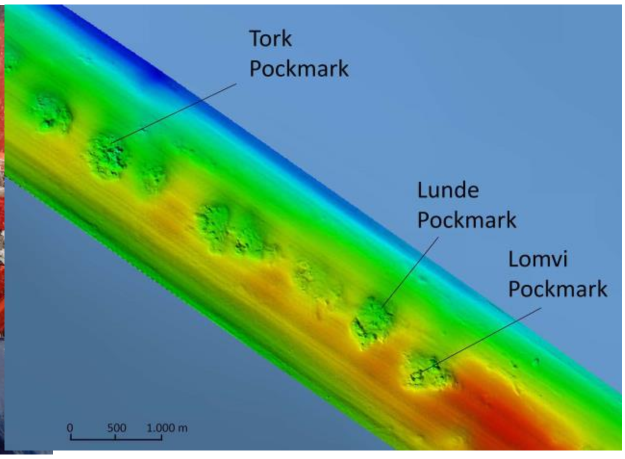

Figure 4: Pockmarks along Vestnesa Ridge, that are characterized by gas emissions were given names by our Norwegian Colleagues using typical Norwegian bird species (map from Stephan Bünz).

Despite the storm over night, data quality was quite well and soon scientists began to investigate the multibeam data more closely. Previous geophysical surveys to the region had shown that the northern portion of the Knipovich Rift is sediment covered. Thus, we were surprised to see clear indications for magmatic structures such as seamounts and volcano-cones in the southern region of our mapping area. High backscatter values from the multibeam system also suggest that the seafloor consists of hard rocks and may not be covered by sediments.

Due to the bad weather conditions, we started our sampling program on Svyatogor Ridge on Friday morning with a five-hour delay. We first deployed the temperature lance along the northern portion of the ridge to investigate a series of pockmarks. A total of 13 stations were completed. A gravity core was then taken within a pockmark that had shown the highest heat-flow value above the regional background trend. The core retrieved a 5m long section of sulfide-rich sediments but with no evidence of methane or anaerobic methane oxidation. After an additional short mapping survey, we reached Vestnesa Ridge and started a new drill site within Lunde Pockmark (Figure 4) in 1200 m of water on Saturday morning. At this drill site we reached a total depth of 22m yielding sediment sequence rich in methane hydrates and carbonate precipitates.

Currently, we are working close to the ice-edge as sea-state and overall weather conditions are more favorable at this location. However, according to the weather forecast, conditions should become again sufficiently stable to allow for MeBo drilling, and we plan to visit several more sites during the remaining five days of our science program at the upper slope of the Svalbard continental margin. All cruise participants are well.

Best regards on behalf of all cruise participants,

Gerhard Bohrmann FS MARIA S. MERIAN Sunday, 28 August 2016