

Research Vessel MARIA S. MERIAN



MSM 57:

Reykjavik – Longyearbyen - Reykjavik
2nd Weekly Report: 1 – 7 August 2016

During our transit northwards to Spitsbergen on Monday, 1 August, we crossed the Iceland Plateau, passed by the volcanic island Jan Mayen at its west side, and arrived at Greenland Basin. Since we left the EEZ of Iceland, we continuously recorded the hydro-acoustic systems sediment echo sounder PARASOUND and multi-beam EM122. By using these systems, we followed in detail all structural units of the seafloor in the European Northern Sea. Thus we crossed the Greenland fracture zone, separating the adjacent Boreas Basin from the Greenland Basin as a distinctive feature. Here the seafloor is rising by 2.000 m water depth within a short distance from 3,700 m to 1,700 m representing an impressive “undersea cordillera”.

On Tuesday we reached our first research area, Vestnesa Ridge, after having crossed the Molloy fracture zone. Contrary to the Greenland fracture zone, the Molloy transform fault is a deep gorge including the Molloy Deep in 5,600 m water depth, representing the deepest site within the European Northern Sea. Active gas emissions and their geological surrounding at Vestnesa Ridge are the target area of the first leg. Our measuring work started immediately on arrival. Vestnesa Ridge is an elongated topographic high in 1,200 m water depth with an overall length of about 100 km. Along its summit, large pockmark structures with some hundred meters in diameter can be frequently found where in numerous cases gas emissions are released into the water column. The most active pockmark field had been investigated in detail 9 years ago by our Tromsø colleagues, including the acquisition of a 3D seismic data set. It was found that the pockmarks are aligned along faults in the subsurface, which serve as conduits for fluids and gas. Our PARASOUND recordings along the ridge show the upper 60 m of the seafloor (Fig. 1). While the stratification of sediments outside the pockmarks is clearly shown, below the funnel-shaped depressions of the pockmarks the stratification is not visible. Those vertical zones are in principle characterized by gas and gas hydrates. We want to find out the detailed structure of these features with our sampling program, mainly by using our seafloor drill rig (MeBo70; Fig. 2 and 3). A whole slew of scientific questions is connected to the pockmarks, and make us look forward expectantly to the recovered cores. With the 3D data available, we decided to drill into Lunde pockmark, as this structure is separated by clear faulting into a SW part with high amplitudes near the seafloor, and a NE sector with seismic anomalies at a depth of 50-70 m.

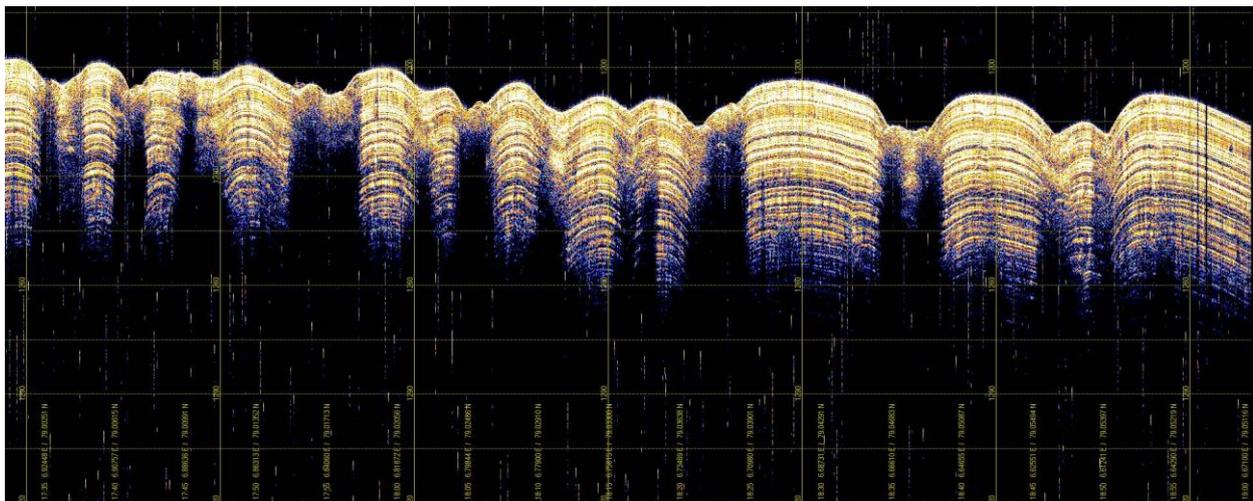


Fig. 1: Sediment echo sound record of seafloor with active pockmark field at Vestnesa Ridge. Chimney-like gas vents underlying the funnel-shaped depression of the pockmark structures at the seafloor.

Gravity core samples already showed this contrast quite clearly: In the SW sector, where at some locations the micro-bathymetry showed high difference in elevation associated with gas emissions,

we could sample gas hydrates near the surface. Whereas NE of the assumed fault we recovered stratified sediments with our gravity corer that are free of gas hydrate. Our MeBo coring in this area represents a continuation of sediment progression from the gravity core with depth. However, at a depth of 23 m we unfortunately had to interrupt the MeBo drilling for technical reasons. The deep sea muds can only be investigated in detail in our home labs, though we had a highlight when several sediment intervals with chemosynthetic clam-remains were found. Those clams live in symbiosis with microbes at the seafloor and were bound with gas seeps. So far those or similar chemo-synthetically living mussels had not been found at Vestnesa Ridge on the seafloor, and it is very interesting to know that this was different in the past. Perhaps these clams had lived in times of stronger methane emission? One clam shell layer so far was known from gravity cores, but now we know that there are several layers and that the methane release probably has varied several times.



Fig. 2: Inner core barrels of MARUM seafloor drill rig MeBo70 on deck of MARIA S. MERIAN, ready for the next deployment.



Fig. 3: After having been recovered by the deck crew, MeBo slides on a rail system to its position on deck for unloading of the core barrels.

From Friday night until Sunday morning we did a background sediment coring at Vestnesa Ridge outside of any pockmarks, in order to compare it to the pockmark environment. For the decision of the right position for drilling, our 3D seismic data were priceless, so that we could exclude any fault, as well as gas intrusions that are not yet percolating to the seafloor. The drilling was the deepest one ever during this cruise with a total penetration of 62.50 m and cored a sediment sequence that so far could not be investigated on the ridge. First macroscopic investigations on the sediment cores showed that alternating layers of silty-sandy horizons with very clean, cohesive clay layers occur that could be a seal for fluid and gas emissions. A real highlight of this coring was the measured distribution of formation gases. The relation of methane to higher hydrocarbons as ethane, propane, butane, etc. is increasing continuously and should mainly be of thermogenic origin, whereas towards a lower sediment depth the part of biogene methane continuously increases. The particular, steep gradient could be explained by the extremely bad routing because of the sealing clay. At this moment MeBo goes back to the seafloor again - during the night and tomorrow we want to drill into an active advection zone of Lunde pockmark that had been interpreted using the 3D seismic data, and investigate those sediments compared to the reference site. We will report on this and whether this was successful, in our next weekly report.

Today it was particularly cold on deck; first snowflakes were seen. Today's very rich and festive Sunday meal thus makes us forget about the weather and everyone is well.

Best regards on behalf of all cruise participants,
Gerhard Bohrmann

RV MARIA S. MERIAN Sunday, 7 August 2016