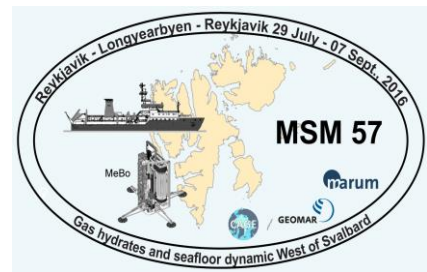


Research Vessel MARIA S. MERIAN

MSM 57:

Reykjavik – Longyearbyen - Reykjavik

Fourth Weekly Report: 15 – 21 August, 2016



After the crew-change in Longyearbyen we started our research studies at the western continental slope off Svalbard. This location is a key site to understand potential climate impacts on the marine gas hydrate system, and has seen an increased attention over the past years by several international scientific groups. Locally focused methane emissions (“gas flares”) from the seabed in about 390m water depth (Fig. 1) were initially discovered 9 years ago by British scientists. This location coincides with the feather edge of the theoretical gas hydrate stability zone along this margin, which lies at around 400 m water depth. A regional correlation of gas emissions above the shallow-water edge of methane hydrate stability has also been noted on other continental margins worldwide. Typically, excess methane is trapped as solid gas hydrate within the sediments in greater water depths.

Using a 30-year-long record of bottom water-temperatures, the British scientists defined an apparent warming trend from 2°C to 3°C for the margin off Svalbard. This warming trend would shift the methane hydrate stability field downward by about 40m. Accordingly, the upper edge of hydrate stability moves downslope to greater water depths, exposing a 1 km wide zone across which gas hydrates no longer are stable. The gas emissions seen along the upper slope at persistent water depths are thus interpreted as a direct consequence of the bottom warming over the past three decades. Although alternate explanations have been brought forward by the scientific community, the “hydrate-melting” hypothesis can yet neither be proven nor rejected due to a lack of ground truth data from greater sediment depths.

So far, no evidence for the presence of gas hydrate has been found using geological sampling with gravity cores or by geophysical remote sensing techniques at this critical region around 400 m water depth. Sampling has been challenged in the past by abundant glaciogenic sediments, as gravity cores cannot penetrate deep enough into the subsurface. We therefore will try using MeBo to reach greater depths; however, we have realized after numerous attempts, that even MeBo has a hard time penetrating these sediment packages, mostly made up of boulder clay, which is a mix of fine grained mud with a variety of clasts and dropstones (Fig. 2).

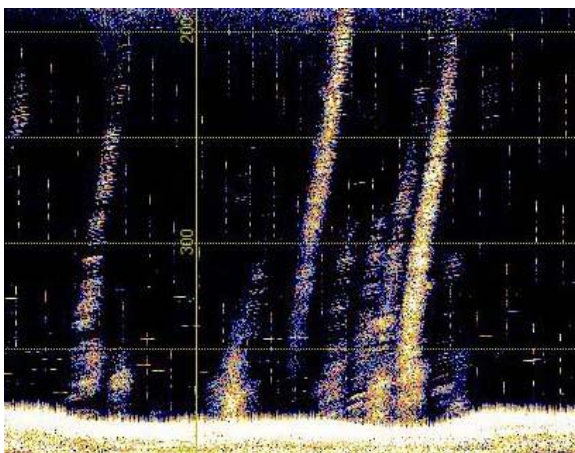


Figure 1: Example of Parasound data showing gas flares in 390 m water depth, west off Svalbard.

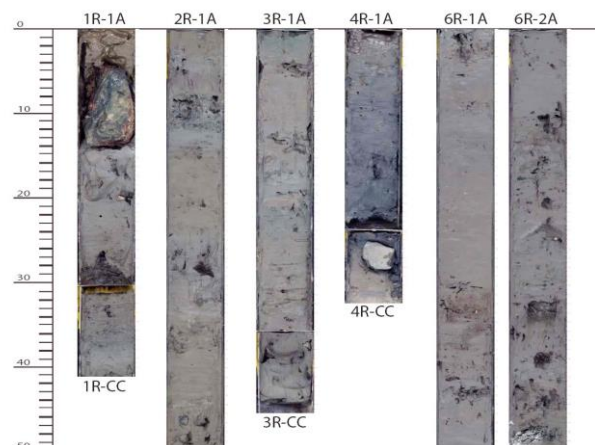


Figure 2: Image of sediment cores taken with MeBo showing glaciogenic clay with a variety of dropstones making coring and drilling very challenging.

These dropstones, carried offshore at the base of former floating ice, fell to the seafloor and mix with regular marine sediments and can be found across the entire study region. Drilling and coring conditions thus rapidly change with depth and provide continuous challenges to our MeBo-drillers. The dropstones often completely block the inner core barrel, preventing it from being recovered and the drill hole has to be abandoned. However, using all kinds of available drilling techniques and many tricks, our MeBo team works hard to recover as much sediment as possible, doing exceptionally well given these very challenging conditions. In total, seven drill holes up to 25 m deep were completed this week, and the recovered sediments were immediately investigated by the onboard science team. No methane hydrates have been recovered from these drill sites yet. However, the team of pore-water chemists (Fig. 4) squeezed the sediments to recover as much fluid as possible and was able to define a surprising freshening trend in chlorinity with depth. This trend alone is no proof of the presence of “melting gas hydrates” at depth, where the potentially liberated fresh water from decomposing hydrates dilutes the normally salty pore-waters. It remains an exciting and intriguing phenomenon, so we will continue trying to shed light into this process of porewater freshening and decomposing hydrates.



Figure 3: View of the MeBo-control station where the drilling is conducted and progress monitored.



Figure 4: View of the chemistry lab, where pore-fluids are investigated for their constituents.

Despite our proximity to the nearby coast only 30km away, we were unable to see any land and enjoy the spectacular views of the mountainous terrain of Prins Karls Forland due to continuous fog and low cloud cover. Yet, the overall low wind speed and small sea state enabled us to conduct all station work safely. Only Tuesday, 16 August, sea state was too high to deploy MeBo, so we started an alternate science program to study the nearby Svyatogor Ridge, located west of the well known Knipovich Ridge. Svyatogor Ridge is a sediment drift complex formerly connected to Vestnesa Ridge. Due to lateral motion along the Molloy Transform Fault, both these ridges were separated from each other during the past 2 million years. The mapping program showed that the crest of Svyatogor Ridge is characterized by numerous pockmarks, similar to Vestnesa Ridge. Using the heat-probe we conducted temperature measurements at 16 stations along three short transects across the ridge crest. These measurements showed that the pockmarks are characterized by much higher heat flow compared to the regions outside these structures. Although we did not find any gas flares using the vessels' acoustic imaging tools, the increased heat flow is an indication of advection of warmer fluids from depths. Today, on Sunday, the science team enjoys a bit of downtime in the overall workload while MeBo continues to drill, a welcome offset from the intense sampling program during the previous nights. Everyone on board is fine.

Best regards on behalf of all cruise participants,

Gerhard Bohrmann

FS MARIA S. MERIAN Sunday, 21 August 2016