R/V HEINCKE cruise HE628

Project ‘FJORDGAS’

<u>Weekly Report</u>

11.09.2023 – 17.09.2023

During the second week of research cruise HE628 we acquired large amounts of new hydroacoustic data and collected sediment and water samples from multiple methane seepage areas successfully that increased our understanding of the gas seep system in Isfjorden. Following a systematic approach we investigated various geological units outcropping at the seafloor that were previously mapped using seismic surveys by our collaborators at UNIS, the University Center in Svalbard. It has been shown prior to our cruise that the distribution of gas emissions is likely controlled by the underlying strata. The goal of our investigations is to methodically map the gas seep distribution in relation to the geological background in order to quantitatively investigate the intensity of the gas release within the western fjords. The most intense gas emissions detected in each geological unit were then sampled to analyse the gas source. A miniaturised remotely operated vehicle (ROV, Fig. 1),built and adapted by MARUM to investigate and sample gas seeps in water depths down to 300 m, provided the first images of some of the seepage areas.

Fig. 1: The MiniROV on deck before deployment. The battery-powered vehicle is lowered to the seafloor within a lander frame and connected to the ship with a fibre optic cable.

Fig. 2: The seeps investigated by the ROV showed microbial mats at the seafloor (upper picture) and carbonate precipitates (lower picture).

Our first dives to seeps in Isfjorden showed microbial mats at the seafloor and also that carbonate precipitates occur even exposed at the seafloor where gas bubbles are released into the water column (Fig. 2). The occurrence of carbonate precipitates makes sediment sampling difficult, as neither the gravity corer nor the multicorer could penetrate through these hard carbonate layers. Nevertheless,

using the underwater acoustic positioning system (GAPS) of R/V HEINCKE we were able to target sampling locations at the seafloor with meter precision and to collect cores right next to the carbonate while still within the seepage areas. These cores contained high amounts of methane, both in dissolved and gaseous phases, and underwent intense degassing when brought on deck (Fig. 3).

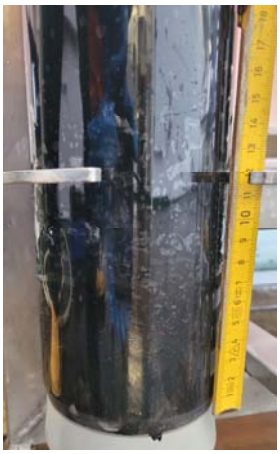

Fig. 3: Sediment core sampled with the multicorer with a high concentration of methane. The corer "bubbled" heavily when brought on deck.

Fig. 4: Naturally released oil bubbles reaching the sea surface and producing a thin oil slick that can be even seen by satellite images.

On Tuesday, 12.09.2023, we left Isfjorden to investigate a recently detected oil seep area on the shelf offshore Prins Karls Forlandet. The oil release was first discovered from satellite images, which showed a recurring oil slick at the sea surface. ROV investigations from colleagues from the UiT Arctic University of Norway in Tromsø confirmed that the surface slick originated from a natural release of oil-coated bubbles at the seafloor. We mapped the area systematically using our hydroacoustic systems and investigated the differences between the oil-coated bubble emissions and other nearby gas bubble emissions without oil leakages. During mapping and sampling stations in that area, we could observe the oil slick and even spot oil-coated bubbles popping up at the sea surface and forming circular oily patches (Fig. 4). Our collaborator from the Norwegian Petroleum Directorate (NPD) provided us with the most recent satellite images, including one taken on the day of our investigations, which showed not only the oil slick that we had observed but also our vessel R/V HEINCKE next to it.

After investigating the oil release at the shelf, another target this week was to look for active gas seepage inside Kongsfjorden, specifically in the vicinity of Ny Ålesund. The presence of gas seepage in this area had been suggested from previous surveys conducted in 2015 with R/V HEINCKE. Surprisingly, despite intense surveying, we couldn't detect any sign of gas release in that area. We decided therefore to transit back to Isfjorden and resume our methodical mapping and sampling approach. After deploying our sonar lander on Saturday morning at one of the most intense flare clusters we detected so far in Isfjorden, we headed towards Van Mijenfjorden on 16.9.2023. The sonar lander will record continuous data for the next five days that will be used for variability studies of the gas emissions. In the meantime, we will investigate now the seep system in Van Mijenfjorden and compare the new observations with our results from Isfjorden. Partly the same geological formations are present in this fjord, and first investigations today have proven already that an active gas seep system does exist in Van Mijenfjorden.

We look forward to pursuing our station work in Svalbard's fjords in the coming week. With many greetings on behalf of the entire scientific crew,

Miriam Römer

Chief scientist on HE628