R/V HEINCKE cruise HE628

Project ‘FJORDGAS’

Weekly Report

03.09.2023 – 10.09.2023

We started our expedition to investigate the gas system in the western fjords of Svalbard (FJORDGAS) on research vessel R/V HEINCKE in Longyearbyen, Spitsbergen, in the morning of Monday, 04.09.2023. All scientists and some crew members arrived two days earlier in order to receive the equipment including sampling gears and laboratory equipment, to install it on board and securely lash it. We were warmly welcomed by the crew and started highly motivated to our sampling and mapping campaign. The scientific team consists of nine participants from the University of Bremen and two from the University Centre in Svalbard (Fig. 1).

Fig. 1: The scientific crew before start of expedition HE628 in Longyearbyen.

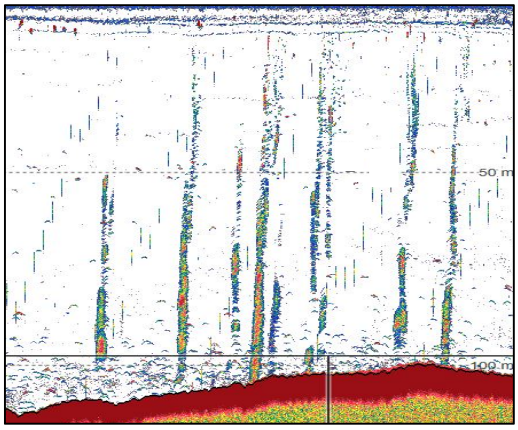

Fig. 2: Seafloor gas emissions causing ‘flares’ in the water column that were detected with the ship’s echosounder in Isfjorden.

The overall objective of our cruise is to quantitatively and qualitatively investigate the currently active gas systems within Spitsbergen’s western fjords. We intend to map and characterize the nature of the gas system, including the sources, amounts, and fates of emitted light hydrocarbons. In addition, the presence of gas hydrates in shallow sediments in the deepest parts of the fjords as suggested by recent modelling studies will be verified by means of targeted sediment sampling. It is expected that the shallow water gas and hydrate systems off Spitsbergen will be relatively strongly affected by bottom water temperature increase due to climate change. Therefore, there is an urgent need to better understand the systems and their variabilities before environmental conditions have changed significantly. Better knowledge of the gas systems in Arctic fjords is needed to assess the contemporary importance of fluid fluxes from the seafloor to the water column and ultimately to the atmosphere, and to provide a basis for future assessments during changing environmental conditions.

We started our investigations within Spitsbergen’s Isfjorden immediately after having left the port of Longyearbyen, and systematically mapped the water column for seafloor gas bubble discharge with the ships echosounders. Numerous gas emissions were detected already during the first week of the investigations (Fig. 2). In order to quantify the amount of released gas we systematically map selected

areas in different parts of the fjords and attempt to understand the controlling factors for the spatial distributions of gas emissions. We hypothesized that gas emission sites are correlated with outcropping geological units. Indeed, our dense mapping strategy applied so far shows that the gas emissions are not randomly distributed in all parts of Isfjorden, but are concentrated in specific areas.

In addition to mapping with the hull-mounted echosounders, several individual gas emission sites were investigated. Water samples and sediment samples were collected with a CTD rosette, a gravity corer and a multicorer, respectively. The multicorer we use was loaned by the Alfred-Wegener-Institute, Bremerhaven, and already provided us some high-quality sediment cores of undisturbed near-seafloor sediments of about half a meter in length (Fig. 3). The gravity corer allows to sample deeper sediments with cores up to 6 m in length. Methane concentrations of water and pore water samples are already determined onboard (Fig. 4), whereas other properties of the sediment cores, such as lithologies and concentrations of pore water ingredients will be analyzed after the cruise in the home laboratories. The results obtained on board allow us to directly evaluate the suitability of the sampled location to discuss further strategies. Because the extent of individual seafloor gas emission sites is restricted, precise seafloor sampling is needed. R/V HEINCKE lacks a dynamic positioning system, but the captain and the nautical officers are doing a great job and have proven their skills in positioning the sampling devices in meter precision to our sampling targets. Nevertheless, sampling seep areas is still challenging. In areas fueling flares, we encountered dense accumulations of precipitates which drastically hampered penetration of the gravity corer. However, such precipitates are probably related to the gas seepage, which will be investigated in more detail during the coming days.

Fig. 3: Several parallel cores of near-seafloor sediments were retrieved with the multicorer. Students Greta and Max are doing the core sub-sampling.

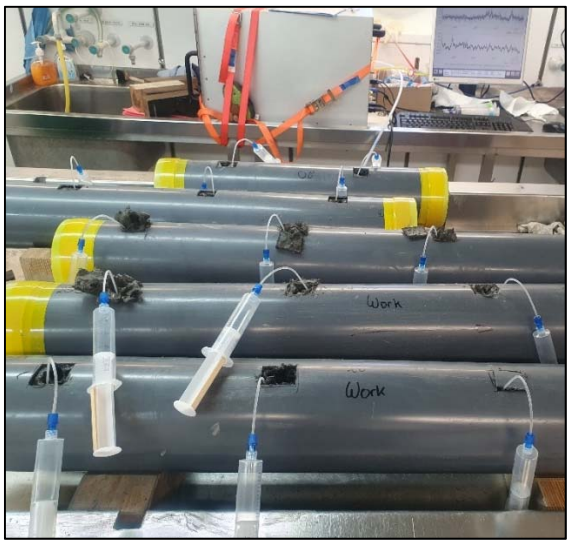

Fig. 4: Sediment cores of up to 6 meter in length are collected with the gravity corer. This core from Isfjorden showed a high gas concentration leading to gas expansion and squeezing out of sediments through the openings in the liner cut out for sampling.

We are very pleased with the first results of this expedition and look forward to the days ahead. With many greetings on behalf of the entire scientific crew,

Miriam Römer

Chief scientist on HE628