Research vessel
MARIA S. MERIAN

MSM131: 18.08. – 28.09.2024
Reykjavik - Emden

Fourth weekly report: 2 - 9 Sept. 2024

The dive on Sunday, 1 September (Dive 483) was already mentioned in the last weekly report but not its results, because these, together with the dive on Tuesday, 3 September (Dive 484), were spectacular for us. We investigated 2 hydrothermal hills whose characteristic appearance led us to name them Yggdrasil and Nidhogg two years ago. These terms, like the word Jøtul, come from Nordic mythology and since these are important objects of investigation for us, we like to use their names and not just numbers. The summit area of Yggdrasil is a very complicated rock structure made up of channels and overhanging roofs, so-called flanges, under which the hydrothermal fluid collects. Since the fluids are hotter and have a lower density than sea water, they flow upwards over the edge, enlarging the edge of the rock roof in a horizontal direction by precipitating metal-rich minerals (Fig. 1). We were able to suck in one such hydrothermal fluid, which had a temperature of at least 289°C, under a flange with our intake nozzle and sample it in the KIPS container. A second fluid sample was obtained with one of the two pressure-tight IGT samplers. While these flange samples come from mid-height of the structure, a second location, namely an outlet channel at the summit of Yggdrasil, was visited. This escaping fluid also had a temperature of 282°C, so it can be assumed that the escaping fluids come from the same source. Two years ago, we also measured a temperature of 272°C at Yggdrasil.

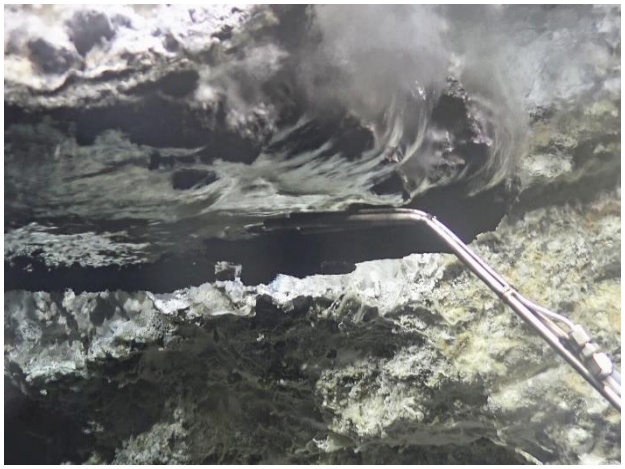

Figure 1: Sampling of a 289°C hot fluid at the Yggdrasil hydrothermal mound in 2900 m water depth with the intake port of the KIPS sampler. The hot fluid is reflected under a rock roof and flows directly upwards at the edge of the flange (© MARUM).

Figure 2: View into the chemistry laboratory of RV MARIA S. MERIAN; here the scientists are processing the valuable fluid samples that were sucked in and sampled directly from the hydrothermal vents on the sea floor using (© G. Bohrmann).

The second part of the dive took us to the Nidhogg hydrothermal mound, about 120 m further west. Here, too, there is a hill structure with a diameter of about 35-40 m, which towers about 10 m above the surrounding area and has a summit area with chimney structures of metal-mineral precipitation. Only a small part of the structure is characterized by active fluid outlets, where the hot liquid appears as intensely shimmering water. We were able to successfully sample such an outlet point here on Nidhogg with KIPS and IGT fluid samplers, measuring temperatures of up to 152°C. Compared to 2 years ago, when we only measured temperatures of up to 33°C, the values this time are significantly higher. In the wider area around the active fluid vents of the Nidhogg, white bacterial mats indicate diffuse fluid flow and whenever we zoom into certain areas with the high-resolution cameras of QUEST4000, we see numerous, often very small

animals, such as snails, worms and various crustaceans. Amphipods can often be seen (Fig. 3), which have a chemosynthetic lifestyle in symbiosis with bacteria.

Figure 3: Accumulation of amphipods only a few decimetres from a hydrothermal vent at Nidhogg, a hydrothermal mound of the Jøtul field in 3012 m water depth; close-up by ROV QUEST (© MARUM).

Figure 4: The "water taxi" of FS MARIA S. MERIAN, which was used to collect the spare part for ROV QUEST brought from Bremen by a MARUM employee at the jetty in Longyearbyen on Friday (© Marco Klann).

In addition to the ROV dives, the fourth week of the expedition was also characterized by an intensive sampling program of the hydrothermal plume in the water column and its effect on the sea floor. So-called Tow-Yo CTD profiles were carried out mainly at night, with the CTD and its water samplers being hoisted and lowered in a zigzag manner along one stretch while the ship was traveling very slowly in the depth range occupied by the hydrothermal cloud. This made it possible to record the area of the hydrothermal plume along the profile and even to track plumes from individual exit points on the sea floor. The temperature and redox potential sensors and the methane, carbon dioxide and hydrogen measurements on water samples from the rosette water were particularly helpful in this. Water samples were taken for later analysis of the helium isotopes in the Bremen laboratory and will inform us about the input of components from the Earth's mantle.

The input of metals from the hydrothermal sources and the distribution via the hydrothermal plume in the Jøtul hydrothermal field will be determined using chemical measurements on surface sediments. To this end, we have set up a large network of 22 mini-corer stations on several days this week, which will be expanded in the coming days. The surface sediments of the mini-corer are of high quality and these stations can also be operated in bad weather when work on the seabed with the ROV is not possible. The programs on the ship complement each other very well depending on the weather. The use of simple sampling devices is sometimes necessary because we unfortunately often have technical problems with the ROV that have to be solved on board by the ROV crew. For example, on Tuesday evening when ROV-QUEST was brought in, the latch system was damaged, which unfortunately could not be repaired on board. It is thanks to several colleagues, and in particular one colleague who arrived by plane, that a spare part was brought from Bremen to Longyearbyen by Friday, which we were able to bring on board in Longyearbyen in front of the harbor entrance using the ship's speedboat, and so we were able to dive with ROV QUEST again on Sunday. The visitors to the German Maritime Museum in Bremerhaven were present with a moderator from the MARUM public relations office and with a teleconference from the ship and, like many others, were able to follow part of the live stream on the YouTube channel.

Greetings on behalf of all participants,

Gerhard Bohrmann RV MARIA S. MERIAN, Sunday 1 September, 2024

Lifestream: https://www.youtube.com/watch?v=BeFz4y_f6pA