FS METEOR
Expedition M192-1 „BRIDGEHELL“
08.08. – 08.18.2023, Pireus – Pireus

1. weekly report (August 08. - 13. 2023)

The FS METEOR expedition M192-1 (**BRIDGEHELL**= **BRIDG**ing hydrothermal sites along th**E** **HELL**enic Arc off Milos from shallow to deep) is the first part of a project that will be continued on the following cruise leg. Scientists, technicians and engineers from the MARUM Center for Marine and Environmental Sciences (University of Bremen), the Constructor University Bremen gGmbH (Department of Physics & Earth Sciences), the Institute of Chemistry and Biotechnology of the Sea (ICBM, University of Oldenburg), the National & Kapodistrian University of Athens (Department of Geology & Geoenvironment) and from the GEOMAR Helmholtz Centre for Ocean Research participate.

The Hellenic Ridge is a volcanic arc along a subduction zone. In such oceanic areas, water is squeezed out of the subducted plate, lowering the melting point of the upper mantle. The mantle melts and magma rises to the surface, where volcanoes form. The region behind the volcanic arc is pulled apart and basins appear. Hydrothermal vents are formed when cold seawater passes through cracks between rocks and gets heated up. In the hot rocks of the ocean crust, circulating seawater is heated and enriched with dissolved metals, sulfides, and gases. Upon contact with the cold, oxygenated seawater, a large number of the dissolved metals and sulfides precipitate immediately as minerals, often leading to the formation of vent structures in a deep-sea hydrothermal system, whereas in shallow-water systems it usually precipitates in a ring around the vents.

Reduced hydrothermal fluids from the Earth's interior and oxidized seawater form an intersection with diverse ecological niches for microorganisms. Some microbes specialize in harnessing the chemical energy stored in dissolved metals, sulfides and gases.

So, in shallow water hydrothermal systems, this is another form of primary production, besides photosynthesis, performed by e.g. algae. In deep-sea systems, the so-called chemosynthesis is the only way of primary production, which is why some animal species have teamed up with these microbes and form symbioses to tap this energy source in the otherwise food-scarce deep sea.

Our goal is to map hydrothermal systems along a transect from the shallow, photic, near-coastal to the deep, aphotic zone further away from the coast and to sample their hydrothermal plumes. We will investigate this on cruise leg M192/1 along the Hellenic arc, a subduction zone with known hydrothermal activity. The Aegean Sea offers ideal conditions for investigating the submarine hydrothermal activity in the transition

between shallow and deep water, as well as the influence of water depths on biogeochemical processes.

The METEOR left the port of Piraeus with 27 scientists of the above-mentioned institutes on board in the morning of August 08. and already 8 hours later we had arrived in our main working area off the Greek island of Milos. The island was created about 2-3 million years ago by volcanic eruptions. These eruptions ended about 90,000 years ago, leaving two inactive craters on Milos. Our work this week focused on the shallow areas south and southeast of Milos. There we turned on the multibeam echosound system and lowered a probe to measure water sound velocity. This creates a sound speed profile to calibrate the echosounder data.

We started in the area south of Milos, because this is where most of the hydrothermal activity is known to occur from the shallow water areas close to the coast, and we used the ship's multibeam echo sounder (Kongsberg EM 710) for the next 10 h. The data were collected from the shallow water areas. In the following days these data were further completed to a bathymetric map (**Figure 1**).

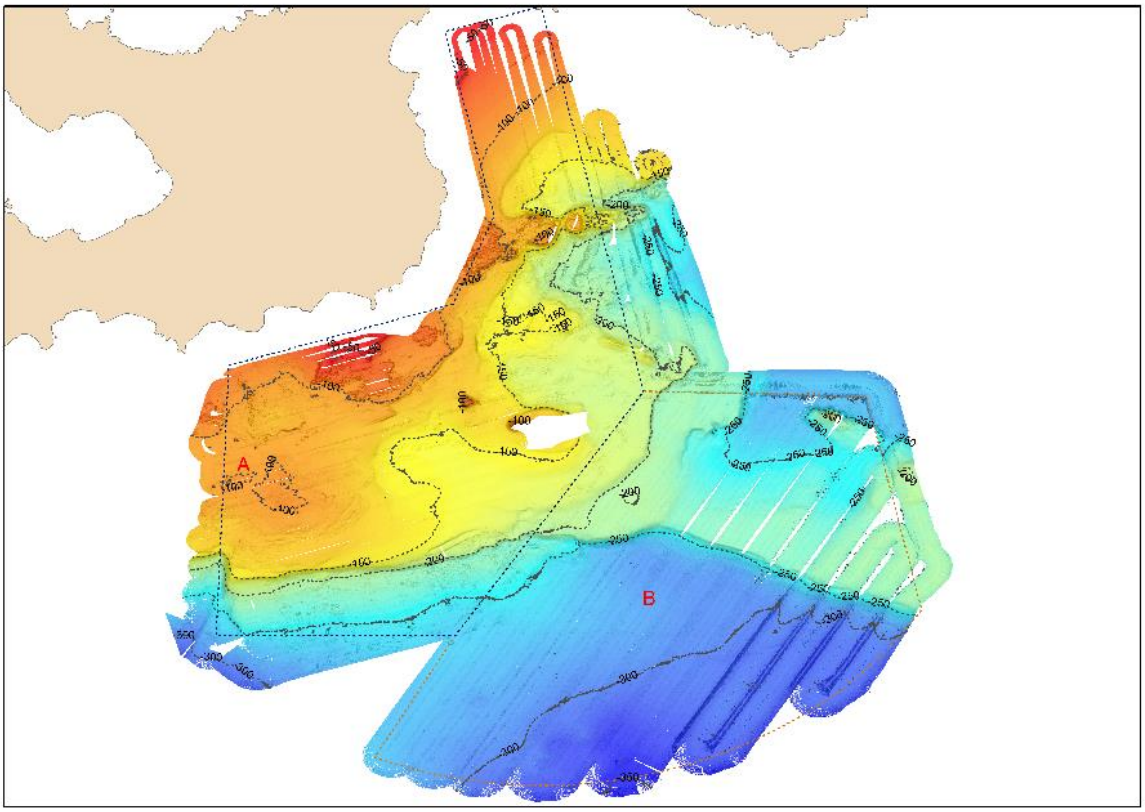

Figure 1: Analysis of Kongsberg EM 710 multibeam echo sounder data on the bathymetry of the study area south and southeast of Milos.

On August 08, the first CTD station (CTD=conductivity, temperature, density) was run, combined with a sampling of the water column in an area at the eastern edge of our study area. This station should be far away enough from the hydrothermal influence to serve as a reference.

Furthermore, three dives have been made so far with the autonomous underwater vehicle MARUM AUV-Seal. Seal maps the seafloor with a SONAR-based device, the Multibeam, and can simultaneously record various sensor data. Compared to deck mapping, this has the advantage that the AUV can record a much higher resolution map than the systems on the ship, at only 40m from the seafloor, and that sensor data are recorded continuously. This data is used to find gas and water venting from the seafloor. Unfortunately, the first dive mission failed to record the multibeam data due to a hard drive failure, but the problem was fixed and so the two subsequent AUV missions provided huge amounts of data that are still being analyzed on board. The resulting maps will be used on the 2nd cruise leg to target interesting vent sites with the diving robot MARUM-ROV Squid (ROV: Remote Operated Vehicle).

Thanks to the prompt evaluation of the multibeam echo sounder data by our Greek colleagues, we were able to find various discharge points of hydrothermal fluids and gases. We have already sampled three particularly pronounced ones with the CTD this week (**Figure 2**). For this, sensor data were recorded and water samples were taken from different depths, within the hydrothermal plume, just above it, in the chlorophyll maximum zone, and in the surface water. These samples were processed by the various teams in the shipboard laboratories and preserved for later analyses of geochemical and microbial composition. Some initial sample characterization data will also be generated directly onboard. Dissolved organic carbon will also be characterized at the molecular level in the home laboratory.

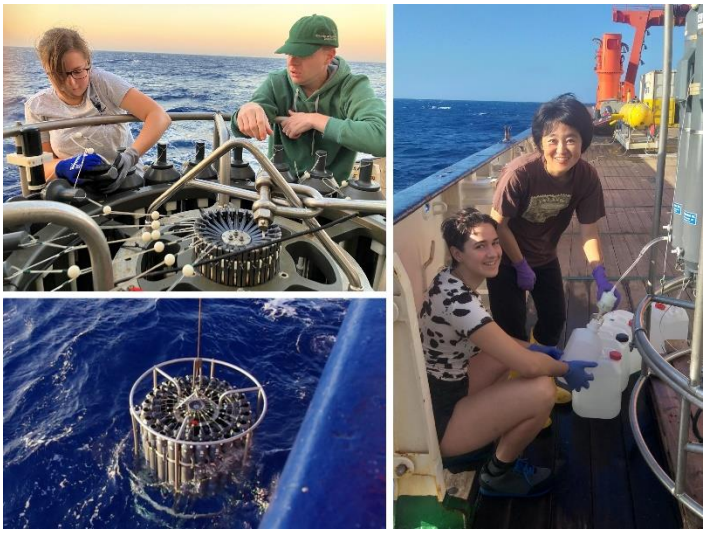

Abbildung 2: Top left: Preparing the CTD with water sampler rosette for deployment. bottom left: The CTD is lowered into the water on the cable via a winch. right: filling the water from the samplers via a filter system. Photos: Erika Kurahashi

In addition, four in-situ pumps were used at each of two stations. They are used to filter large quantities of the hydrothermal plume waters. On the one hand, these filters will be examined with regard to their microbial community and biomarker analyses will be carried out. Among other things, it will be investigated how the "old" hydrothermal carbon is transported into the biomass of the overlying water column.

Milos is always in sight during our work. Even though the influence of the Meltemi (the prevailing wind of the summer months in the Aegean from northerly directions) caused a swell on some days, the weather was overall very nice. It was an extremely successful first week, thanks to highly motivated scientists and excellent support from the entire ship's crew!

With best regards, also on behalf of the rest of the participants,

Solveig Bühring & Andrea Koschinsky At sea, 36°N, 24°E