

FS Maria S. Merian cruise MSM 04/3
First Weekly Report, period 23rd – 28th January



On the 23rd of January the German research vessel Maria S. Merian set out with 14 scientists, 9 ROV (remote operated vehicle) crew members and 21 crew members from Fort de France, Martinique, to investigate the Logatchev hydrothermal vent field at 14°45'N, 44°58'W on the Mid-Atlantic Ridge. This cruise is part of the German Science Foundation's Priority Program "From Mantle to Ocean" (DFG-SPP 1144) in which geologists, fluid chemists, geophysicists and biologists work together to unravel the mass and energy transfer taking place from the earth's mantle to the ocean.

We have the ROV Jason II from the Woods Hole Oceanographic Institution on board, which we will use to recover long-term experiments left by a previous cruise with R/V Meteor, re-deploy instruments and collect various types of samples from the 3000 m deep seafloor of the hydrothermal vent field.

Jason II has never been used with a German research vessel before, and although it still seems a miracle to us that we managed to adapt this complex system based on inches, pounds and American power requirements to a metric ship, we were still able to mobilize within only 3.5 days. This could only be accomplished with the exceptional support in every respect of the ship's crew. After successfully testing Jason II with a "harbor dip" on the morning of the 23rd January, we were ready to leave port according to schedule. During the transit to the Logatchev field, the scientists were very busy setting up their laboratories while the ROV team had the chance for additional testing of their vehicle. After 3.5 days of transit we arrived on the 26th January at the Logatchev field. The weather is good, the sea is calm, and the conditions for diving with a ROV are fine.

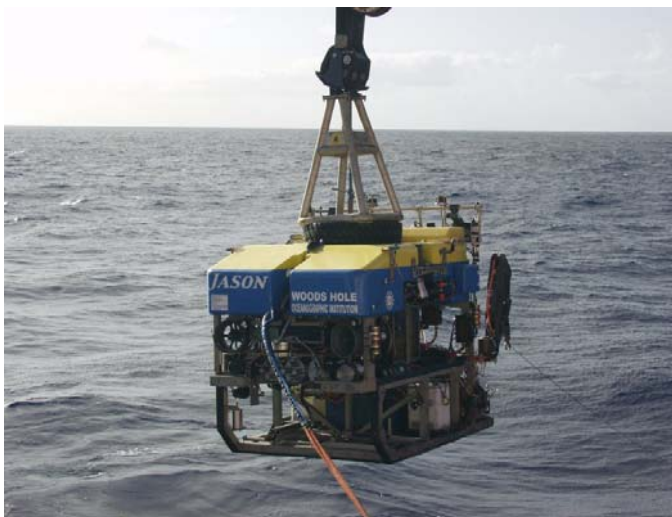


Fig. 1: The ROV "Jason 2" being launched over the side of R/V Maria S. Merian.

The first dive lasted 8 hours and proved successful, as hot hydrothermal fluids were measured and collected from the Irina II chimney structure, which we determined for the first time to emerge with temperatures of up to 350°C. Fluid samples collected with titanium syringes served for onboard analyses of gases (hydrogen, sulfide and methane) and other organic and inorganic compounds. The first culture experiments of the microbial communities were started. Mussels which host chemosynthetic symbionts in their gill tissues were collected in order to perform incubation

experiments on board. Other macrofauna, e.g. limpets, shrimps and brittle stars will be analysed in the home laboratories.

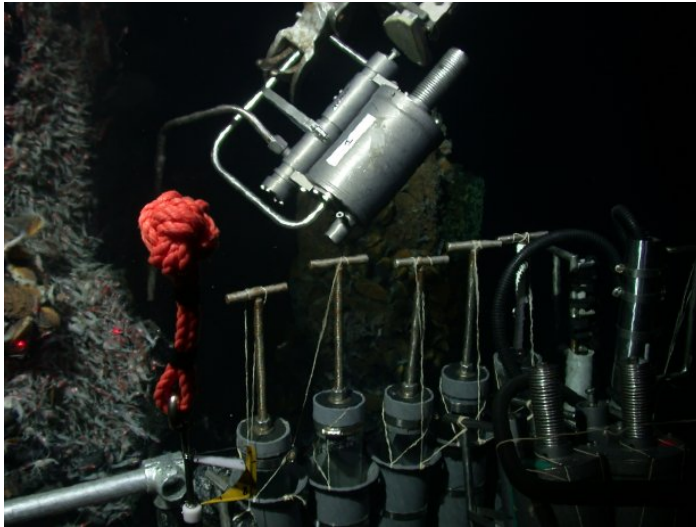


Fig. 2: Sampling hot fluids from the Irina II main structure with a titanium syringe.

The second dive proved equally successful as geophysical instruments were recovered after having been on the seafloor for 20 months. The ocean bottom tilt meter (OBT) and ocean bottom pressure meter (OBP) recorded local seafloor dynamics related to hydrothermal activity and tectonics. The two instruments were still in a good condition and readings of the logged data indicated that they had worked successfully for more than a year. The recovery of these data therefore marks a milestone for reaching the time-series related goals of the SPP 1144. Another major target of this dive was the “re-location” of a previously observed site with microbial mats which is located next to marker “Anyá” north-west of the Irina II structure. Here we positioned an in-situ profiler that measures the horizontal gradients of environmental key parameters controlling the hydrothermal microbial communities, such as concentrations of hydrogen sulfide, hydrogen, oxygen, temperature and pH at a micro-scale. This profiler will later be used at different hydrothermal environments including mussel beds. The microbial mat was also sampled with push cores for ex-situ experiments on microbial turnover processes and for genomic analysis of the microbial population.

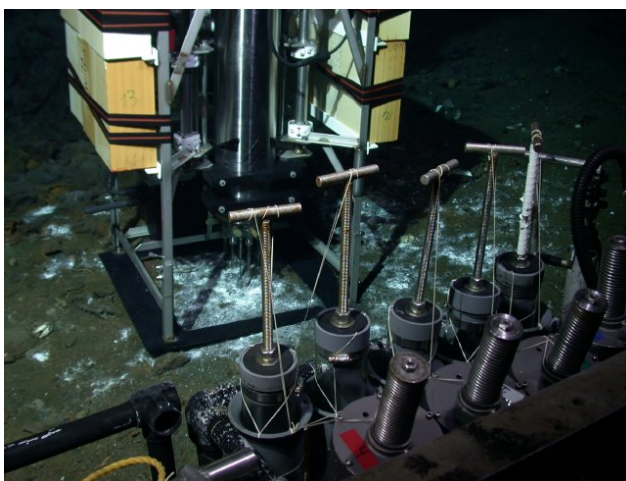


Fig. 3: Positioning of the profiler on a microbial mat.

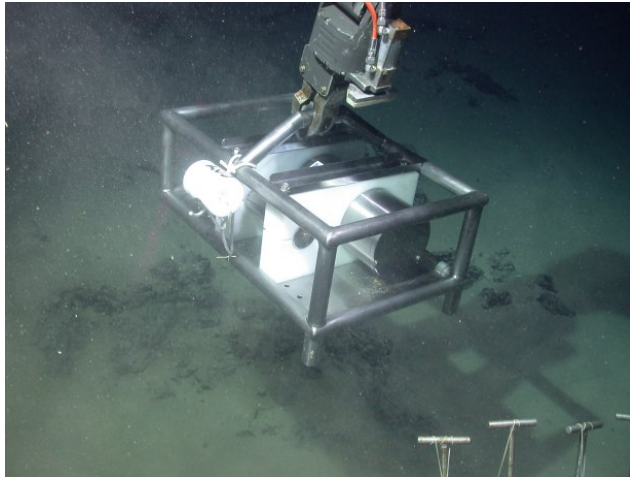


Fig. 4: Recovery of the OBP after 20 months exposure to seafloor.

While Jason II dived during day time, we dedicated our first night in the research area to the detection of the hydrothermal plume in the water column by CTD casts.

An unusual incident on Sunday elucidated very clearly how small and vulnerable we are in the middle of the ocean. A German sailing boat which was only 35 nm miles apart from our position at Logatchev had a broken mast and asked for support with food, water and diesel in order to be able to continue sailing with reduced speed to their destination in the Caribbean. We interrupted our research and searched for the only 10.5 m long boat which we met around midnight. The two sailors were well and we supplied them with what they needed before they continued on their way and we took on with our work. We wish them good luck and hope that they will arrive safely!

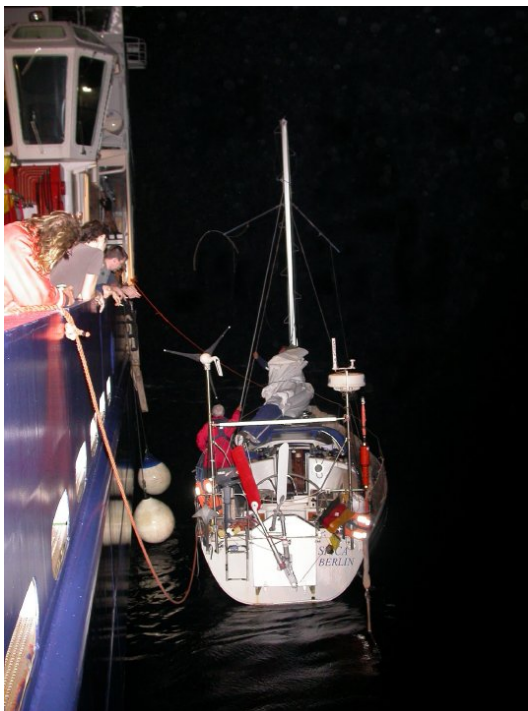
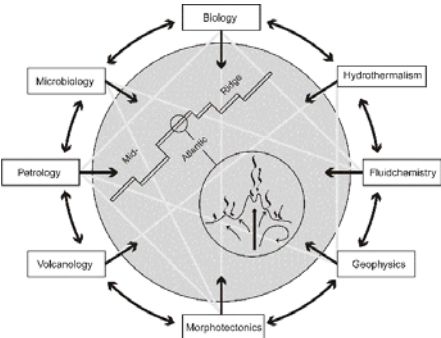


Fig. 3: Sailing boat with broken mast alongside Maria S. Merian in the middle of the Atlantic Ocean.

With only 14 scientific participants, the science group is comparably small and the demands of shift work during daytime dives and work on samples and experiments

during nighttime can easily build up a challenge for everybody. However, the cooperation between ROV team, ship's crew and scientists is excellent and we are all in a very good mood and are looking forward to another 10 very successful working days at Logatchev.

We are all in good health and send our best wishes.
Christian Borowski and the MSM 04/3 shipboard party.
29th January 2007



DFG-SPP 1144

S Maria S. Merian cruise MSM 04/3
Second Weekly Report, period 29th Jan. – 4th Feb.



The second week of Merian cruise MSM 04/3 continued very similar to how the first week ended: diving with ROV Jason during daytime and running CTD casts or bathymetry mapping profiles during nighttime. With a moderate sea state of 1.5-2.5 m wave height driven by the steadily blowing ENE to E trades, the weather did its best for us and diving was possible every day. The air temperature is around 25°C and the sun is shining every day, only sporadically interrupted by a few light showers, which makes life on board very agreeable.

Initially we kept up a regular pattern of 12 hours water time for the ROV which allowed us to recover sample material every night. This was necessary because many biological samples and gas analyses on hot fluids required rapid recovery and immediate processing. Later in the week, we had also two 24-hour dives, which allowed us to extend our operation radius on the seafloor. Our diving activities during 9 days of station work now sum up to 8 dives with 85 hours bottom time.



Fig. 1. Dense aggregation of the shrimp *Rimicaris exocculata* at the “Irina II” main sulfide structure.

The main target of this week’s dives was the Irina II mound and adjacent areas, including the main sulfide structure on the top with hot fluid outlets and dense aggregations of mussels and shrimp, the mussel field on the western mound slope, the so called “OBT site” at its northern margin, and flats with bacterial mats and cracks with diffuse outflow adjacent to marker “Anya”. Another frequently visited site was the smoking crater structure Quest, which served as a reference site for the Irina II analyses, while the smoking craters in the southern part of the Logatchev field were visited with one dive.

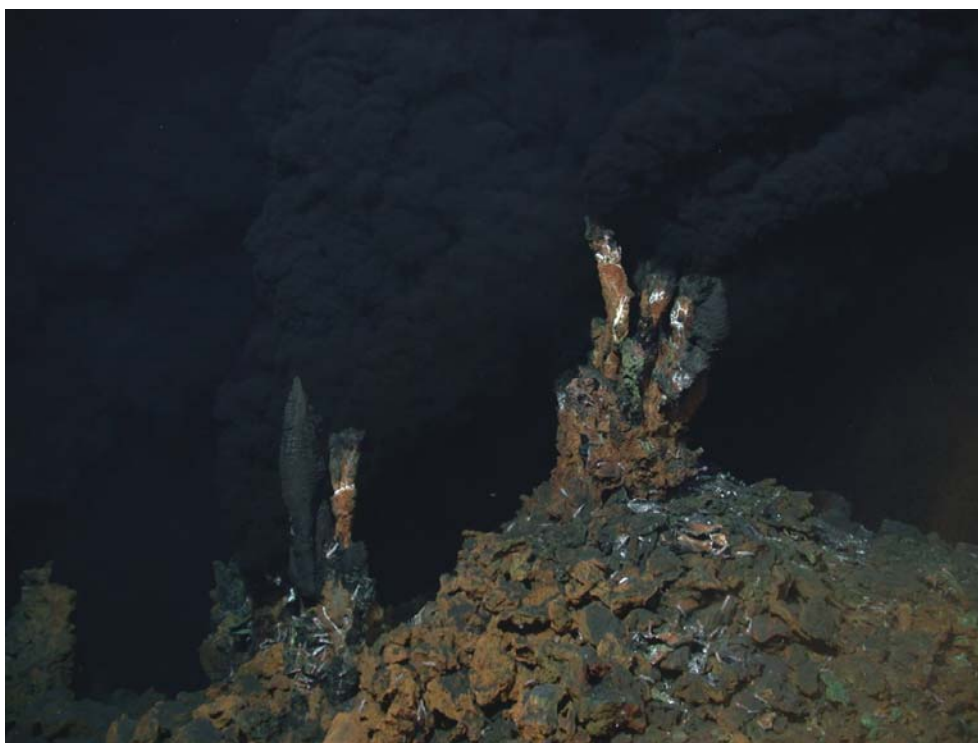


Fig. 2. Black smokers along the rim of the smoking crater “Anna Louise”.

During repeated visits of Irina II and Quest structures, we collected sample material for successive onboard incubation experiments with microbes and symbiotic tissues as well as analyses of hot and moderately heated fluids. Physical and geochemical gradients at hot and moderately heated hydrothermal environments were measured by a 8-channel high-T probe mounted to the ROV and a micro-profiler measuring gradients of T, O₂, sulfide and H₂ above mussel fields and in the upper inter-individual space. An in-situ incubation chamber was used for mussel incubation experiments on O₂ respiration and sulfide depletion.

All instruments deployed by Meteor cruise M 64/2 are now recovered, including the ocean bottom tilt meter (OBT), the ocean bottom pressure meter (OBP), the 25-m long vertical temperature mooring and arrays of single miniaturized temperature loggers (MTL) in the Irina II mussel field and the smoking crater site Quest. Readings of the temperature loggers revealed that these instruments have collected data until late 2005, which matches the initially planned duration of their stay on the sea floor. The new OBP, OBT and one set of 10 MTL were deployed again with three successive dives.

One important task of this cruise is to verify the geographical positions of the various previously mapped hydrothermal structures on the basis of long baseline navigation (LBL) used by Jason. As one important result, we have calibrated an offset for previously reported positions. Another perhaps even more important finding is that previous cruises have underestimated the number of hydrothermal structures. Dive 257 ROV revealed that the southern part of the Logatchev hydrothermal vent field additionally to the three previously mapped smoking craters “Site B”, “Irina I” and “Anna Louise” harbors a fourth crater structure which is located between “Anna Louise” and “Site A”. Although this structure was already found by Meteor cruise M 64/2, it was not recognized as a new one and marked as “Anna Louise”. We

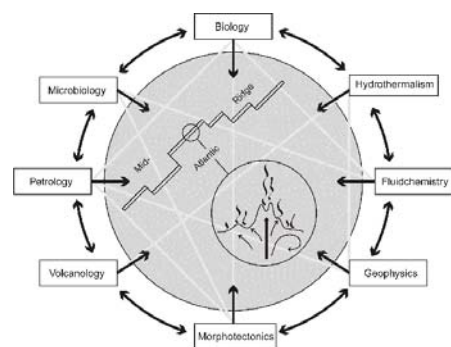
named the structure “Smoky Strobe”, which refers to a strobe light that apparently was lost by a towed video sled and which we found lying next to the crater rim. With an estimated diameter of 10 m, “Smokey Strobe” is considerably smaller than neighboring craters.

Three “tow-yo” CTD stations were carried out during this week. The CTD–rosette was alternately lowered and raised through the water column as the instrument was dragged about 500 meters behind the ship at a speed of 0.5 knot. In this way, properties such as particle concentration could be mapped throughout the plume interval of about 2500 to 3000 meters. In addition discrete water samples were captured and analyzed for methane, hydrogen, and trace metals. Due to the serpentinization of mantle rocks, the Logatchev vents emit high concentrations of these chemicals, which appear as plumes in the surrounding waters. The tow-yo measurements indicate that one plume was spreading along the 2750 meter contour to the south and east. To the northeast, it may be that the plume spreads at a deeper level, but this is not as clear.

In two nights between ROV dives, the bathymetric mapping at the transition of the Mid-Atlantic Ridge to the Fifteen-Twenty Fracture Zone was continued which was started Sunday night during the rescue operation of the S/V Spica. The mapped area covers a so-called inside corner at a mid-oceanic ridge transform fault. In such settings very often lower crust and upper mantle material outcrops along large detachment faults, showing characteristic corrugation marks which strike parallel to the spreading direction. Therefore it was the need to map the area in a higher resolution than the available Japanese and French bathymetry of R/V Yokosuka and R/V Atalante, respectively. The transits from the Logatchev Field to this area were planned along different routes, so that also a considerable part of the Mid-Atlantic Ridge Central Valley next to the Logatchev Field could be mapped. The data show a large fault striking N/S which basically can be traced from the Logatchev Field approximately 40 km to the north. It can be speculated that such faults are directly correlated to hydrothermal systems and serve as pathways for the hot fluids.

At the end of this week of very intensive work and, we feel as if we have been here for a long time although we arrived only 9 days before. The days are long while the cruise is short, and we have only three days left until we will leave again and head to Las Palmas.

We are all in good health and send our best wishes.
 Christian Borowski and the MSM 04/3 shipboard party.
 4th February 2007



DFG-SPP 1144

Maria S. Merian cruise MSM 04/3
Third Weekly Report, period 5th – 11th February



In the beginning of week three, the winds picked up to 15 m/s and wave heights increased to 3.5 m. However, diving with ROV Jason II from the Woods Hole Oceanographic Institution was still possible. We continued work on Monday morning as planned while we watched the weather, and we were prepared to break off the dive at any time. On the next morning the wind had calmed down again and we were able to dive every day. The nights were again filled with CTD-casts which were closely connected to the MAPR-profiling performed in the preceding week. The water samples obtained by the CTD casts will be analyzed, a.o., for the contents of CH₄, H₂ and He in the hydrothermal plume, which will be later used to model the turnover processes of these volatiles. The 25-m long temperature mooring was re-deployed on Monday about midway between Irina II to the north and the smoking crater of site “B” to the south.

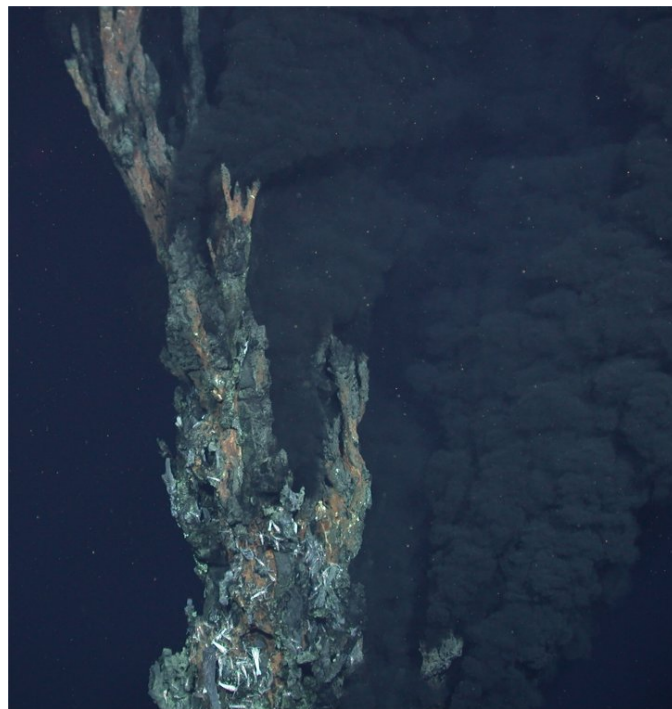


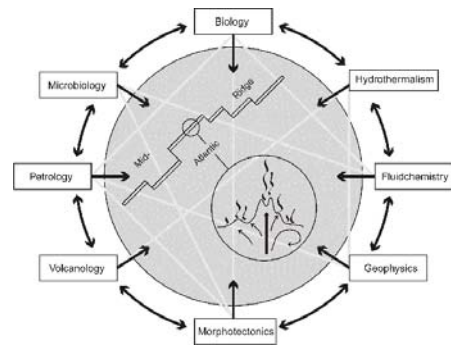
Fig. 1. Top of the chimney Barad Dûr at Site “A”.

The dives of these days continued with the general program of the preceding week around the Irina II mound and Quest: Sampling of fluids, sediments and mussels for ex-situ incubation experiments with microorganisms and symbiotic tissue in the lab, setting out the in-situ profiler for measurements of geochemical gradients above mussel beds at a micro scale, sampling of hot fluids for the determination of the fluid compositions. Additionally, during the Monday dive we re-deployed the OBT, which we had recovered only a few days before. Although this instrument had been sitting on the sea floor for 20 months, its general condition and the state of the batteries proved to be sufficiently good to be used again. Thus two OBTs that will be recovered in November 2007 are currently measuring sea floor tilt at Logatchev. During this dive we sampled also site “F” between the northern and the southern field structures, which is a sedimentary area covered by white bacterial mats. The

Tuesday dive was dedicated to fluid sampling at the hydrothermal structures of the southern field including the Barad Dûr chimney at site “A”, Anna Louise, Irina I, and site “B”. The Wednesday dive was only a short one and served to complete work that could not be finished before, such as the re-deposition of temperature loggers at the Quest site. During this dive we also “cleaned up” the sea floor by collecting all items which had been left during earlier dives but which were not meant to stay.

Finally we completed work on Wednesday with a total of 11 dives and 105 h of bottom time during 12 days on station. On Wednesday, 07th Feb. 19:15 we left the working area after picking up the navigation transponders and started to transit to Las Palmas, where we will arrive in the morning of Wednesday 14th Feb. We are very happy about the success of our cruise, which was a result of good cooperation between the science group, ROV-team and ship’s crew, and last not least also of good weather for the entire stay in Logatchev.

We are all in good health and send our best wishes.
Christian Borowski and the MSM 04/3 shipboard party.
11th February 2007



DFG-SPP 1144