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While the ROV was still finishing sampling in the known vent fields Turtle Pits, Red Lion and Wideawake, the AUV ABE had already found several new locations with indications of hydrothermal input in an area between the hot vent fields Turtle Pits and Red Lion, and at other sites, displaying anomalies in turbidity, temperature and redox potential. Also the photo mapping with ABE had recorded clear indications, such as mussel patches, of hydrothermalism. Consequently, this area was chosen for the 4th dive of the ROV on May 14. After just one hour on the bottom, the ROV had already found its first target: a 12 meter-high chimney and black smoke were the clear signs for another high-temperature field. According to its appearances with two distinct spires on the wide base this one was named Twin Peaks. After a thorough observation and first sampling the ROV continued its way according to the data of the AUV dive evaluation and in the afternoon it reached a fissure with intense colonization of mussels and other animals. Diffuse fluid flow was clearly visible.

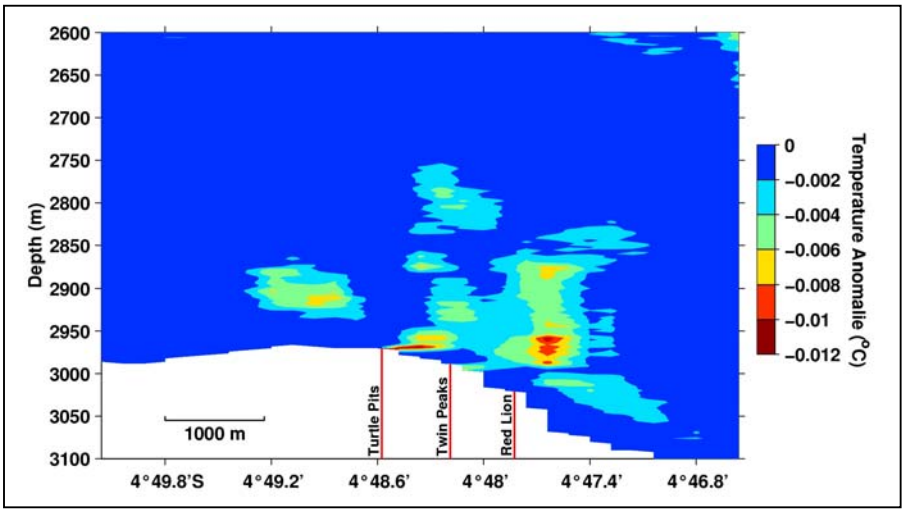
Sampling of fauna in a valley unusually densely inhabited with Bathymodiolus mussels in the 5°S area (Photo:MARUM)

In the evening shortly before its ascent, the ROV reached the 3rd hydrothermally active site, which was characterized by high turbidity of the water – probably caused by bacteria. This new locations became the starting point for ROV dive no. 5 the next morning. It is also a low-temperature diffuse source, however, it differs in its appearance and colonization from the previously discovered mussel valley, which was also revisited to sample mussels and fluids. The remaining time was dedicated to the hot smoker Twin Peaks. Temperature measurements revealed 399°C, which in comparison to the maximum temperature of 407°C at Turtle Pits is also a very high temperature. Fluid-chemical investigations in the ship's lab confirmed that this systems boils and the fluids are phase-separated, similar to Turtle Pits.

As further work in the 5°S area, a number of CTD stations were carried out. North and south of the 5°S area 2 hydrographic profiles were carried out (CTD/LADCP/130 He samples). The currents are consistently northward although partly with a westward component, slightly modified by tidal currents. The average current velocity below 2400m depth was 5 cm/s, with maxima of more than 15 cm/s in a northerly direction. For the purpose of long-term observation of the background current and for the precise determination of tidal amplitudes and phases, a current meter mooring was deployed in the area, which will remain there for one year.

Deploying the CTD/MAPR combination from a drifting ship (Tow-yo) produced 3 high-resolution transects of temperature anomalies and turbidity both along and across the axis of the valley. Plume anomalies were detected in several density layers and

could partly be assigned to the known vent fields (Turtle Pits, Twin Peaks, Red Lion). The maximum anomalies were found always north of the sources, which is consistent with the current direction. Several weaker signals lie south of the known vents and indicate the presence of further (possibly diffuse) hydrothermal sources.



Anomalies of the potential temperature along a south-north oriented tow-yo track. Positions of the hydrothermal Turtle Pits, Twin Peaks & Red Lion are marked in red (Figure: C. Mertens)

After 6 very successful working days we decided to leave this area at 5°S, which is extremely interesting for our SPP program, and look for new discoveries. A transit of 25 hours to the next target area at 9°33'S was welcome to work up the samples and data and to prepare for the new site. The 9°33´S site is much shallower (1500 m) than the 3000 m deep sites at 5°S. As hydrothermal fluids in shallower areas have lower maximum temperatures and consequently lower metal contents, turbidity signals due to metal precipitation are often missing in the rising plume. Therefore, the localisation of hydrothermal emanation sites by means of CTD and AUV deployments becomes more difficult.

A diffuse hydrothermal field, which was called Lilliput during its discovery cruise in 2005 because of the high abundance of very young mussel populations, was already known. While the AUV was searching for signals of active hydrothermal venting around the Lilliput field, the ROV had to stay on deck for a day. A complicated problem in the winch for the A-frame made a deployment of the ROV impossible. Finally the efforts of the chief engineer and his team were successful and the ROV descended immediately at 5 p.m. on May 18 for its 6th dive. This dive started in a diffuse site that we had observed during an OFOS track in 2005 and continued over a bizarre underwater landscape consisting of lava pillars, lava domes and wide caves and finally led us to a diffuse-flow mussel field just south of Lilliput. We made use of the fact that we had to let the AUV pass on its way north for a final sampling before ascent. The photo mapping and sensor records of the AUV 5 m above the seafloor revealed further strong signals of hydrothermal activity, which were followed on May 19 during the 7th ROV dive. Besides the known Lilliput field more diffuse active emanation sites north of Lilliput were discovered and sampled. Besides the common mussels, shrimps and crabs,

also dense accumulations of hydrozoans, gorgonians and some tube-forming worms could be observed.

„Roman Ruins“: in the area 9°33’S the ROV flew over structures consisting of lava pillars and domes over a wide range (Photo: MARUM)

Even though we did not find any high-temperature field in the area at 9°33’ S, which had been expected based on a clear anomaly of gases and metals about 300-400 m above the seafloor, we can still consider this leg of the expedition with its diverse occurrences of widespread low-temperature hydrothermal activity very successful. It could also be shown that the AUV with its sensors is able to detect shallow, low-temperature fields without problems. Now one more working area at 7-8°S is still ahead of us.

With best wishes from R/V Meteor
Andrea Koschinsky and participants of M68/1