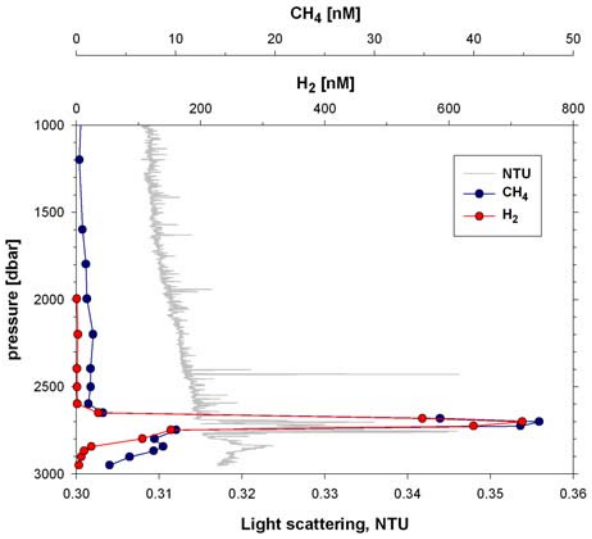
5th Weekly Report M68/1, 20-28 May, 06

After about 7 hours of transit from the diffuse hydrothermal area at Lilliput (9°33'S) to the Nibelungen field at 8°18'S the first station on May 19 was a CTD station destined to confirm the hydrothermal plume that was found here during cruise M62/5 in December 2004. This area, which had already been investigated during this former cruise with extensive CTD work and ROV deployments, is characterized by very complex current patterns and temporal variability of the location and intensity of the hydrothermal plume. Therefore, it had not been possible to detect the exact location of the vent site and the whole area had been named „Cheating Bay" – a name it was to live up to during our cruise as well!

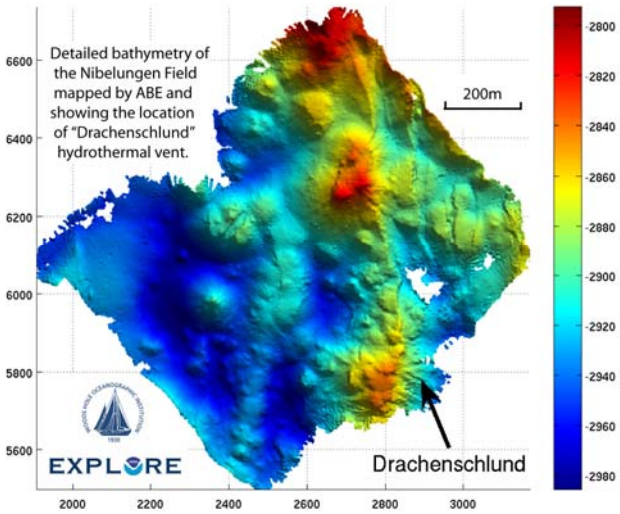


Methane, hydrogen and turbidity anomaly at 2700 m water depth in the CTD profile above the Nibelungen field (Graph: O. Schmale)

Nevertheless, the CTD station data could immediately confirm the existence of the plume at the expected water depth 300 m above the seafloor, and the coordinates for the first dive of AUV ABE could be set. Hydrogen and methane reach very high concentrations in a depth of about 2700 m, correlating with the turbidity signal and Fe concentrations. The very high ratio of hydrogen to methane pointed to an ultramafic production of these gases.

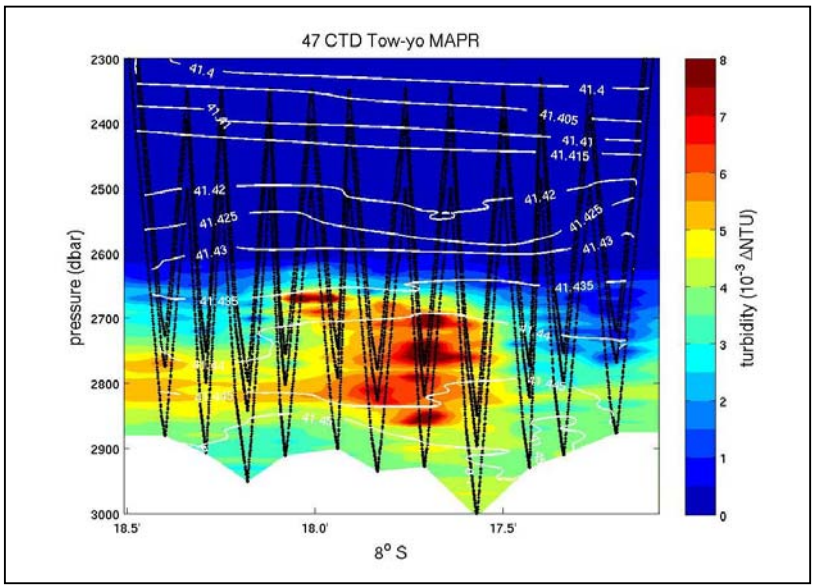
Even with the most systematic search strategies, which had been proven to be very successful several times during this cruise, sometimes one needs good luck. So was the case with the use of ABE to discover the elusive Nibelungen field this past week. Based on extensive data from CTD stations and the phase 1 dive, we were ready to plan phase 2: seafloor mapping and proposed interception of a buoyant hydrothermal plume. Allowing for the effects of strong currents in the area we constructed out 1 km^2 search area. Despite being as cautious as we thought necessary we were rather perplexed that our chosen Phase II survey results revealed NO buoyant plume signals within our chosen survey area. At the very start of the 2nd ABE dive, however, we have programmed the AUV to drive along a track that ran just 20-30m east of our phase 2 survey. And there, within 20 minutes of ABE arriving on the seafloor, we found the tell-tale signals of a high-temperature hydrother-

Map: C. German, D. Yoerger



mal vent in water that was sufficiently buoyant that it pushed ABE upwards 3m through the water column as it passed over the site. In an extremely fast turn around time of just 6 hours the ABE engineers had the vehicle recharged and re-programmed to dive straight back to the seafloor and photograph the vent-site. Only 12 hours later we could look at a series of pictures looking down on tall extinct chimney "stalagmites" and, in one 90-second period, the view we most wanted to see – nothing but thick black smoke rising up from the seafloor and blotting out ABE's field of view.

Two CTD Tow-yo tracks confirmed the strong temporal variability of plume dispersion in cheating bay: during one station, the plume signal was clearly visible east of the now known position of the source, another time west of it. This can be attributed to strong currents changing in tidal cycles, which are additionally modified by the irregular topography.



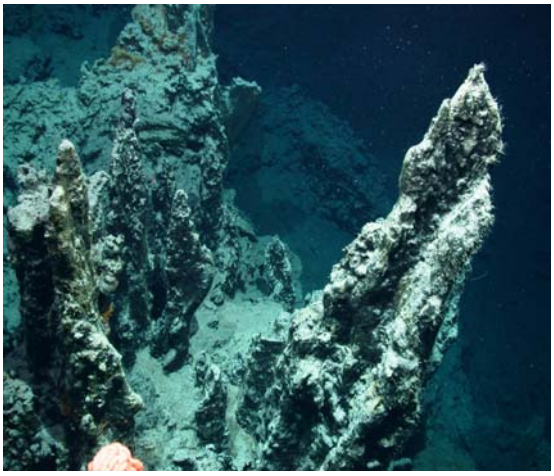
Turbidity anomaly of a Tow-yo track with CTD and MAPR (Miniature Autonomous Plume Recorder) across the plume dispersion in the Nibelungen field. The cause of this anomaly, the black smoker 'Dragon Throat' is situated at 8°17.9'S. White lines represent areas of equal density along which the water spreads, black lines denote positions of the different instrument along the sections (graph: M. Walter, C. Mertens)

Now that the location of the Nibelungen field was identified, "Cheating Bay" one more time tried to escape a more detailed investigation, because the increasing winds and strong swell made the deployment of the ROV impossible. So we had to be patient until on May 24 the weather had improved somewhat. After only 20 minutes on the bottom Quest had already found the source of the strong redox, temperature and turbidity anomalies that ABE had located: "Dragon Throat". This vent does not represent a chimney structure, but is a four meter deep crater with a diameter of about half a meter, from which an enormous volume of black smoke emanates at high velocity. This crater looks similar in its appearance as the smoking craters that we had found in the Logatchev field for the first time.

The smoking crater„Dragon Throat" in the Nibelungen field (Photo: MARUM)

As the crater hole has high walls on three sides and is only accessible through a narrow opening at one side, we had to deal with the "curse"of Cheating Bay one more time.

It was not possible to insert the temperature sensor and the fluid sampling nozzle deep enough into the crater hole to measure the exit temperature (which we estimate to be at least 350°C) and sample an endmember fluid. But still shipboard analysis of the fluid samples gained above the crater throat could immediately prove to us that the Nibelungen, as we had already assumed, is a vent characterized by serpentinization processes. The extremely high concentrations of methane and hydrogen and very low concentrations of free hydrogen sulfide, due to the high Fe/S ratio and consequent precipitation of sulfur as sulfide, clearly indicate a reaction of the fluid with mantle rocks. Thus, we have discovered an ultramafic system comparable to the Logatchev field, situated at nearly the same water depth of 3000 m. This discovery supports the theory that such systems should be a wide-spread phenomenon on the slow-spreading MAR, while our young volcanic hydrothermal field at 5°S on the MAR is a more unexpected type of hydrothermal system for the MAR.



Inactive chimneys in the Nibelungen field (Photo: MARUM)

As the ROV was only deployed again after the location of the Nibelungen field was known, the intermediate time was used by a CTD Tow-yo for preparing another target area at 7°57'S for AUV dives. This area in the A1 segment close to Ascension had shown turbidity and temperature anomalies during CTD stations and TOBI sidescan sonar deployments of former cruises. These anomalies apparently originated from terrace structures at the western rift valley, close to the center of the segment – a geological situation similar to the Logatchev field at 15°N on the MAR. The Tow-yo data of the oceanography team could indeed identify a distinct plume with its maximum turbidity anomaly lying directly above terraces cut into the valley walls. The AUV dive phase 1 localized the hydrothermal signals and also a dredge along the slope recovered hydrothermal breccia, so that the 2nd dive phase of ABE could be prepared. However, as this dive did not result in the clear localization of the hydrothermal source, as we had hoped for, we stopped work in this area for the rest of this cruise, because station work time was coming to its end and a further search did not appear useful. Instead, the station work was finished with a dredge in the Nibelungen field, a CTD station and an ROV dive in the Lilliput mussel field at 9°33'S, where again mussels were recovered for experiments with the symbiotic bacteria and where fluid and lava samples were taken from the area with the lava columns.

With best wishes from the Meteor
Andrea Koschinsky and participants of cruise M68/1