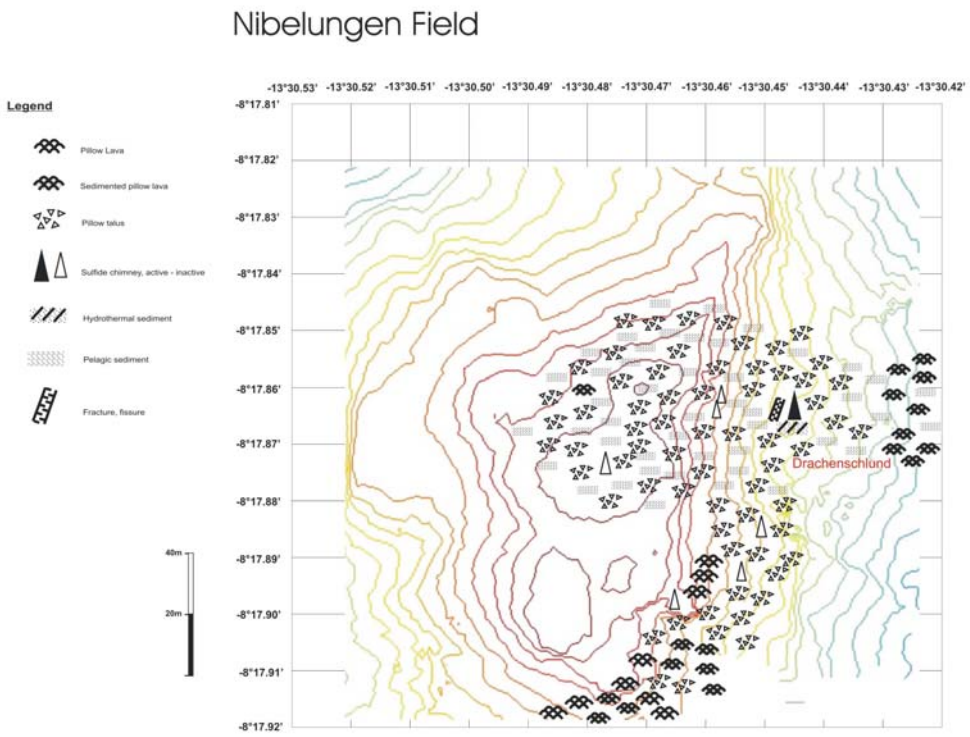
6. Wochenbericht M68/1, 28.5.-2.6.06

Our 5-day return transit to Recife began at midday on Sunday 28.5. immediately following the last scientific activity – recovering ABE´s transponders at the last site near 7°58´S. A grill party on deck as we sailed past Ascension Island, presentation of some certificates, distribution of the baptism newspaper and a song for the Captain from the hastily assembled but completely commited ship´s choir lent a particular atmosphere to this wonderful evening. The lab work didn´t stop with this party, however, there were still hydrothermal fluids to analyse, biological and geological samples to conserve and pack, and masses of bathymetric, hydrographic and other data to be processed. In parallel with this we started packing the 7 containers which will leave the ship with us, so there was enough for everyone to do! On Wednesday afternoon we had a scientific meeting to review the results of the cruise, here is a short summary of what was presented:

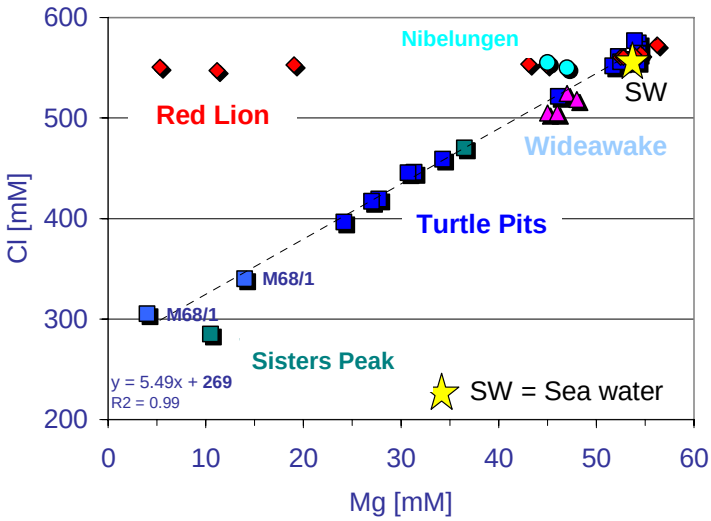
The combined deployments of AUV, ROV and CTD meant that, in addition to revisiting and better characterising the four fields known from last years cruise, we were able in only three weeks to find and investigate three more fields at 5°S (one hot vent, two diffuse flow areas), three more diffuse fields at 9°33´S and to finally locate the elusive Nibelungen field. Two further attempts, at 8°10´S and 7°58´S, to find hydrothermal vents had to be curtailed prematurely due to time limitations – the data collected will however allow the next cruise to the area to refine the search appreciably. During the 10 ROV dives we collected numerous lava, sulphide, fluid and biological samples.



Map of the Nibelungen Hydrothermal Field, based on the results of the ROV deployments (map by B. Melchert)

The analyses of the fluids carried out on board show them to cover a broad compositional spectrum. The Turtle Pits vent "Two Boats" is, at a temperature of 407° not only the hottest known fluid worldwide but also characterised by phase separation and the venting of a salt-poor and hydrogen, iron and copper rich supercritical vapour phase. The newly

discovered “Sisters Peak” vent has a very similar chemistry although “only” venting at 400°C, suggesting it is fed from the same source. In contrast, the four smokers in the Red Lion field, with temperatures between 190° and 349°C and chlorinities similar to seawater do not seem to have experienced phase separation. The various diffuse sites show a range of concentrations of such dissolved substances as sulphide, hydrogen and methane, features that are probably related to their colonisation. We found copper-binding ligand activity in the waters of all the diffuse vents which is probably the result of detoxification compounds being produced by the vent animals. The fluids from 5°S and 9°33´S are clearly influenced by reaction with basalt, whilst the Nibelungen vent “Drachenschlund” gushes water which has clearly reacted with ultramafic rocks, as testified to by their high methane, hydrogen and iron contents. High copper contents and H_2/CH_4 ratios suggest a relatively high venting temperature for the waters – we were not able to measure this directly as the vent itself was inaccessible for the ROV.



Plot of chlorinity against magnesium content in the samples collected during M64/1 and M68/1. Pure seawater contains ca. 54mM of Mg whilst it can be assumed that pure hydrothermal fluid is Mg-free. Turtle Pits and Sisters Peaks show phase separated, low chlorinity fluids whilst Red Lion and Nibelungen have seawater chlorinities. (Graphic: D. Garbe-Schönberg)

The hydrothermal fauna can be divided into three types communities associated with diffuse flow, smoker chimneys and the Nibelungen vent. Bathymodiolus-Mussels with varying size distributions dominate the diffuse Wideawake and Lilliput sites. Occasionally the much rarer Calyptogena clams are also present. At the Wideawake mussel sites, usually somewhat apart from the mussel thickets, one could occasionally find a rarity in the Atlantic, the white clam Calyptogena sp. In the mussel thickets, by far most frequent were the molluscs: small gastropods dominated in the southern fields, two kinds of limpets at the northern sites. Predators are represented by various polychaete worm groups, crabs and a large conid snail. Shrimps are much more rare than at the hot smokers where they form the dominant species. The mussel *Bathymodiolus* sp. is regularly, but patchily, found attached to crevices and even vertical walls of the smokers, and crabs searching for prey are a typical picture. Summarizing, the fauna at the hot smokers, although spectacular in their close contact to the hot effluents, has a lower diversity than that of the vent mussel fields and is clearly dominated by the white shrimps. The surroundings of the powerful smoker “Drachenschlund” at Nibelungen were devoid of the typical vent fauna except for numerous parchment-like, flexible tubes of chaetopterid polychaetes which were attached to the loose alterated rocks and sand of the crater walls. In comparison, the M68/1- studies of fauna communities in the MAR hydrothermal fields south of the equator show essentially the same taxonomic composition and ecological structure as those in the north. Despite some taxonomic differences, this overall correspondence could not be anticipated considering the huge Romanche Fracture Zone which might have been a barrier restricting or at least filtering dispersal of vent animals. The data of M68/1 so far underline the conclusion drawn from the results of M 64/1 that de-

lineation of a separate zoogeographical province for the South Atlantic vent sites near the equator is not required.

Top: Tube of a polychaete, which was sampled at the crater walls of „Drachenschlund“ in the Nibelungen field

Left: The typical white vent shrimp Rimicaris and its smaller relative, Mirocaris (Photos: O. Giere)

Bathymodiolus mussels are so successful at hydrothermal vents due to their symbiotic bacteria, which can oxidise reduced species such as sulphide, hydrogen and methane present in the hydrothermal fluids at high concentrations. The bacteria use the energy from this oxidisation to fix inorganic carbon into organic compounds which can be used by the host. Laboratory studies on bacteria-containing gill tissue combining the expertise of the symbiosis and gas chemistry groups have shown that both hydrogen and hydrogen sulphide are used as energy sources by the bacteria whilst methane consumption could not be shown. First results also suggest that the concentrations of the individual reduced compounds has a direct influence on the activity of the symbionts.

In summary, we achieved more than had been originally planned and proposed during the cruise. The optimal combination of equipment on board, the professionalism and motivation of the participants and the excellent support by all the ships personnel made this such a successful trip. We wish to express here our heartfelt thanks to Capt. Kull, his crew and everyone else who supported this cruise. We can hardly wait to get home now to start working on the exciting samples we have collected!

For the last time this cruise we send greetings from Meteor
Andrea Koschinsky and the participants of cruise M68/1