

## Meteor Berichte 05

### *Mid-Atlantic Expedition 2005*

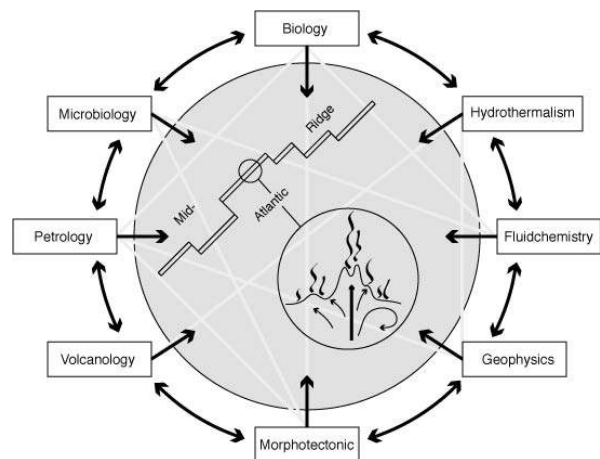
Cruise No. 64, Leg 1

# MARSÜD 2

2 April – 3 May 2005, Mindelo (Cape Verde) – Fortaleza (Brazil)

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2005

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## 1. Leg M64/1

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#### Abbreviations:

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## **1.2. Research Program**

Mid-ocean ridges are unique features of the Earth where energy and material is exchanged between the Earth's interior and the surface. This cruise is part of a DFG Priority Programme "From Mantle to Ocean: Energy, material and life cycles on spreading axes" designed to obtain a four-dimensional picture of the processes operating at mid-ocean ridges. In this context the overall goals of the planned investigations are as follows: (1) to determine the volcanic and tectonic dynamics operating at mid-ocean ridges as well as the geochemical and biological processes occurring at active hydrothermal vent areas shall be characterised in detail as a function of space and time and (2) to link the hydrothermal processes to the volcanic activity on the axis. The target area of Leg 64/1 is one of the two key areas of the Priority Programme 1144 on the Mid-Atlantic-Ridge (MAR) planned to be investigated by petrologists, biologists, chemists, geochemists, geophysicists and oceanographers. It is situated between 7 and 12°S along the MAR south of the Ascension fracture zone (Figure M64/1-1). This section of the MAR is highly variable in morphology, crustal thickness, and magma composition and is thus an ideal region to study the diversity of magma transport and volcanic eruption processes and their influence on the formation and evolution of hydrothermal vents and associated biological processes. Leg M64/1 is a follow-up cruise of Leg M62/5 during which the foundation for this cruise – a detailed geologic and tectonic map of the seafloor and the position of hydrothermal plumes – has been obtained by using a TOBI combination of deep towed sidescan and nephelometry and a Remotely Operated Vehicle (ROV) and a CTD/Rosette. Based on this data our research group will select hydrothermally active sites and characterise them volcanologically, geochemically and biologically by taking and analysing rock samples, samples of hydrothermal fluids, samples of the micro- and macro fauna and samples of the water column in the vicinity of those vent areas.

## **1.3. Narrative of the cruise**

The cruise started in Mindelo with some minor problems with the transport of crew members and with the successful loading of the heavy ROV containers with an ancient swimming crane. In the morning of April 2<sup>nd</sup> FS METEOR left the port of Mindelo and steamed southwards to the first working area on the Mid-Atlantic Ridge near 5°S. Throughout the cruise we had warm and calm weather and only for a couple of days the wind rose to a strength of 6 and the swell increased to about 3 m. In the evening of April 7<sup>th</sup> we arrived in the first working area at the location of the Turtle Pits hydrothermal field which was discovered only weeks before by a British-American cruise and the location of which was kindly forwarded to us by C. German and T. Shank. During the night the area was mapped with Hydrosweep after we had one CTD/rosette station outside of the ridge area in order to determine the background water composition. Unfortunately, the CTD failed and no water samples were recovered. On the morning of April 8<sup>th</sup> we performed the first dive (#36, station 108) with the MARUM QUEST ROV and after a few technical problems the ROV reached the seafloor at around noon. Towards the end of the dive we found two inactive black smokers and deployed a sonar buoy. During the night two TV grab and several wax corer stations recovered basaltic lava and CTD/rosette stations were carried out to determine the location of the hydrothermal plume. MAPRs were also deployed with each wax corer and TV grab in order to study the areal extent of the plume. On April 9<sup>th</sup> the second ROV (#37, station

114) dive found the active chimneys situated in a north-south running depression and we started photographing, sampling and measuring the different structures. Between April 9<sup>th</sup> and April 15<sup>th</sup> five dives with the ROV were performed mostly during the day with CTD, wax corer and TV grab stations during the night. In most dives we studied the Turtle Pits field but one dive (#39, station 125) led to the Wideawake mussel field for geological, biological and fluid sampling. On April 16<sup>th</sup> a very long dive (#42, station 146) was performed starting south of the Turtle Pits field and ending at the Red Lion hydrothermal field where one active smoker had been reported by our British-American colleagues. While diving at this location we found four active smokers and numerous inactive structures with a peculiar fauna consisting of impressive numbers of shrimps. After this long dive we had a 24 h transit to the working area at 8°50'S on the MAR.

Work in this area started with a detailed bathymetric survey of the large volcanic field on segment A2. After that the lavas of the volcanic field were sampled using the wax corer and the ROV during two dives in order to study the volcanology and geology of the area. Surprisingly, much of the volcanic field was covered by sediments although the sidescan maps showed a very high reflectivity. CTD and MAPR stations in the area of the volcanic field did not show any hydrothermal signal and we concluded that the southern part of segment A2 is probably both volcanically and hydrothermally inactive. After three days of work on segment A2 (April 18<sup>th</sup> to 21<sup>st</sup>) we continued hydrothermal exploration on segment A3 using wax corers with MAPRs and CTD/rosettes. 186 CTD station showed a strong methane anomaly but the nephelometers did not record any anomalies in the water column. On April 23<sup>rd</sup> and 24<sup>th</sup> we performed two dives on the shallowest part of segment A3 near the near-axis seamounts in order to study the volcanology and sample lavas. On the night from April 24<sup>th</sup> to the 25<sup>th</sup> five CTD stations defined the location of a potential hydrothermal vent to be within the area between 9°32.5'S and 9°33.0'S. Studying the bathymetric and sidescan maps indicated that the most likely location of a vent would be the neovolcanic zone with a narrow cleft. On the morning of the 25<sup>th</sup> the ROV dive led us from one of the CTD stations with an anomaly to the east toward the neovolcanic zone. At about 12 o'clock we found the first hydrothermal sediments and mussel shells and at 15:55 we discovered the active low-temperature Lilliput hydrothermal field. The name was given because of the overabundance of small baby mussels. Biological, geological and fluid samples were taken. During the night two TV grab stations recovered more hydrothermal sediment, lava and biology from this field. On the next morning the ROV started the dive but technical problems required to retrieve the ROV after 2 hours from the water. The final stations of cruise M64/1 consisted of CTD, wax corer, and TV grab stations and one camera sledge tow across the neovolcanic zone. On the 27<sup>th</sup> at 15:00 we finished our work and RV METEOR started its voyage to Fortaleza. The ROV team was busy repairing the damage in the high voltage unit of the ROV and was successful so that by the time of arrival in Fortaleza most of the damage was repaired. Early in the morning on May 3<sup>rd</sup> METEOR arrived in Fortaleza after a very successful cruise.

## **1.4. Preliminary Results**

### **1.4.1. Geology and petrology**

#### **1.4.1.1. Geological setting and lava petrology of the area at 4°48'S on the MAR**

(K. Haase, S. Fretzdorff, H. Paulick, D. Unverricht)

The Turtle Pits hydrothermal field occurs in a N-S striking row of collapse pits in a large sheet flow whereas the Wideawake Mussel Field occurs in a jumbled sheet flow. The abundance of fresh glassy sheet flows in the area suggests a very strong volcanic activity and the youngest observed lava covers parts of the Wideawake Mussel Field in the SE and is thus probably less than 10 years old. The segment was seismically active in June 2002 (C. Devey, pers. comm.) and one can speculate whether the seismic activity occurred during the eruption of the lava flow. These observations indicate that this segment of the MAR is currently in a volcanic rather than in a tectonic phase. The tectonic features of the MAR at 4°48'S all strike in N-S direction, for example, the major faults at the rift flanks, minor faults observed during ROV dives as well as volcanic features in the rift. Interestingly, the shallow rift flanks of the MAR at 4°48'S suggest variable volumes of magma production.

The volcanic rocks in the region surrounding the Turtle Pits hydrothermal and Wideawake Mussel fields have been sampled very detailed using the rock corer, TV grab and the ROV. Fourtytwo samples have been selected from the recovered lavas covering an area of about 3 x 3 km<sup>2</sup>. Most of the lavas in this region are very fresh aphyric sheet flows with ropy and jumbled surfaces. Collapse structures with lava pillars are frequent in the sheet flows. Young lava flows also occur in the deep basin between the Turtle Pits hydrothermal field and the axial seamount (e.g. sample 146ROV-2). The freshness and the predominance of sheet flows in the region implies very strong volcanic activity and eruption volumes in this segment of the Mid-Atlantic Ridge. Pillow lavas occur only in few areas, for example, on the small seamount west of the Turtle Pits field and on the very young lavas in the south of the Wideawake Mussel field.

Most lavas are glassy and aphyric without vesicles suggesting that the magmas were undersaturated with volatiles either due to the high water pressure or low volatile concentrations. From the axial seamount and from two locations on the eastern flank of the neovolcanic zone we recovered lavas with large (up to 1 cm) plagioclase crystals. One TV grab station recovered aphyric sheet flows containing abundant gabbroic xenoliths up to 8 cm in diameter with clinopyroxene to 8 mm and slightly smaller plagioclase crystals.

#### **1.4.1.2. Geology and lava petrology of the large volcanic field at 8°50'S**

The TOBI sidescan mapping during cruise M62/5A provided structural maps of the MAR between 7 and 12°S. Volcanic features can be very well distinguished and one of the largest and most interesting features in this segment is a volcanic field with a young appearance on the sidescan map. This volcanic field is defined based on a very similar reflectivity which is interpreted as lavas of approximately similar age in an area some 10 km long and 2 km wide. Large parts of the volcanic field consist of flat lava flows but at the western edge two rows of eruption centres are aligned in sigmoidal, about 3 km long lines probably overlying two major feeder dikes for the eruptions. Furthermore, several single volcanic features occur on the

volcanic field, most notable being an approximately 50 m high pancake shaped volcano with very steep cliffs. The sidescan map suggested a very young age of the lavas without obvious faults cutting the lavas. However, during the ROV dives we found some cracks and up to 15 m high faults running through the central part of the lava field implying that significant tectonic movements have occurred after ceasing of the volcanic activity, i.e. the segment probably is in a beginning tectonic rather than in a volcanic stage. The lavas are also covered by 1 to 2 cm thick carbonate pteropod/foraminifera ooze, especially in the central part whereas many lavas in the north appear to be less sedimented and younger. This may indicate a variable age of the different parts of the volcanic field.

Thirty samples of mostly glassy basalt were recovered by ROV dives and wax corer from various positions along the volcanic field. We especially sampled different small volcanic cones along the presumed eruption fissure in order to determine the heterogeneity of the erupting magmas. In contrast to the 4°48'S region the predominant lavas in the 8°50'S volcanic field are pillow lavas which appear to cover the central part whereas sheet flows are more abundant in the north. Here we observed frequent changes between pillows and sheet flows during station 159 (dive 44) and we also found collapse structures and lava pillars typical for fast eruptions. Consequently, the eruption volumes and the velocities must have varied with more lava erupting in the north.

#### **1.4.1.3. Geology and lava petrology of the hydrothermal field at 9°33'S**

The Lilliput hydrothermal field at about 9°33'S lies in the segment A3 which has a significantly thickened crust of about 11 km thickness based on gravimetric modelling (Minshull et al., 2003). The morphology of the A3 segment is reminiscent of the fast-spreading East Pacific Rise with a neovolcanic zone occurring on a shallow ridge with a narrow cleft rather than in a deep rift typical for the slow-spreading Mid-Atlantic Ridge. The cleft is some 900 m wide and 20 to 30 m deep with an about 10 m high volcanic ridge in the centre. The hydrothermal field lies in a water depth of about 1500 m in a pillow lava flow disrupted by several deep faults striking approximately 345°. South of the hydrothermal field we found very young-looking sheet flow lava flows suggesting that recent volcanic activity occurs in this part of the A3 segment. Possibly, these lava flows represent the heat source for the hydrothermal convection cells. Alternatively, the thick pillow flow itself may have initiated the hydrothermal circulation because hot water was observed to stream out of cracks in large pillows and most of the hydrothermal sediment is Fe-oxide/hydroxide crusts.

#### **1.4.2. Description of hydrothermal precipitates**

(S. Petersen, H. Paulick)

Hydrothermal precipitates were recovered from the Turtle Pits and Red Lion hydrothermal fields at 4°49'S as well as from the Liliput hydrothermal field at 9°33'S. The samples consist of massive sulfides, sulfide-oxide-sulfate breccias, and Fe-oxyhydroxides and are described below in detail. Major and trace element geochemical and mineralogical studies will be performed on these samples (S. Petersen, IFM-GEOMAR), as will be sulfur isotopic investigations (H. Strauss,



Uni Münster). Selected subsamples were taken for age dating in order to document variations with time (J. Scholten, Univ. Kiel). All samples will be archived at IFM-GEOMAR.

Note: Positions of the TV-grabs within the Turtle Pits field are preliminary and need to be recalculated!

Table 1.1: Hydrothermal precipitates

No.	Date / time	Lat / Long	Depth wire	comment
<b>Turtle Pits</b>				
114ROV-4	10.04.05/03:55	South Tower 4°48.579'S/ 12°22.420'W	2990 m	Black smoker chimney from SE base of tower (heading 336)
114ROV-5	10.04.05/04:15	South Tower 4°48.579'S/ 12°22.420'W	2990 m	Lower part of structure (heading 294)
114ROV-6	10.04.05/05:00	South Tower 4°48.579'S/ 12°22.420'W	2986 m	Near top of structure at western side (heading 084)
114ROV-7	10.04.05/05:09	South Tower 4°48.579'S/ 12°22.420'W	2986 m	Near top of structure at western side
123ROV-4	11.04.05/13:50	Marker 1 4°48.588'S/ 12°22.414'W	2986 m	Eastern side of Marker 1 chimney, sampled in bionet
123ROV-9	11.04.05/16:50	Pinoccio 4°48.562'S/ 12°22.419'W	2990 m	Small knob on western side of the inactive Pinocchio chimney
124GTV	11.04.05/22:11	4°48.58'S/ 12°22.42'W	2998 m	1000 kg of massive pyrite (inactive chimney) sampled from sheet flow at western edge of the field
130ROV-1	13.04.05/14:39	Mk 2 BS 4°48.573'S/ 12°22.421'W	2985 m	Sampled in bionet during attempt to sample fauna
130ROV-2	13.04.05/14:57	Mk 2 BS 4°48.573'S/ 12°22.421'W	2985 m	Sampled in bionet during attempt to sample fauna
131GTV	13.04.05/21:05	4°48.57'S/ 12°22.37'W	2999 m	Fe-oxyhydroxide stained fresh basalt, plume fallout sampled in graben east of Pinoccio
139GTV	14.04.05/20:17	Mk 2 mound 4°48.573'S/ 12°22.421'W	2985 m	1000 kg of massive sulfide, hematite-magnetite-sulfate material, and chimney debris from western flank of Marker 2 mound
141ROV-6	15.04.05/	4°48.56'S/ 12°22.41'W	2985 m	Six pieces of pyrrhotite-rich chimney material
146ROV-3	16.04.05/20:24	4°47.90'S/ 12°22.62'W	3045 m	Inactive sulfide structure on the way to Red Lion

**Red Lion**

146ROV-7	16.04.05/22:57	4°47.82'S/ 12°22.60'W	3048 m	Flange of Shrimp Farm in the Red Lion vent field
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**Liliput**

200ROV-5	25.04.05/13:01	9°32.93'S/ 13°12.51'W	1494 m	Fe-oxyhydroxide crusts
200ROV-7	25.04.05/15:48	9°32.88'S/ 13°12.55'W	1495 m	Fe-oxyhydroxide crusts
209GTV	26.04.05/14:53	9°32.86'S/ 13°12.52'W	1511 m	Fe-oxyhydroxide crusts, basalt glass chips and fauna
213GTV	27.04.05/01:58	9°32.83'S/ 13°12.55'W	1513 m	Fe-oxyhydroxide crusts, basalt glass chips and fauna
214GTV	27.04.05/03:55	9°32.84'S/ 13°12.54'W	1511 m	Fe-oxyhydroxide crusts, basalt glass chips and fauna

## **Turtle Pits area**

### **Station 114ROV (dive#37):**

During this dive chimney samples were recovered from the Southern Tower structure at Turtle Pits. The black smoker samples consist of porous chalcopyrite-rich pieces with minor pyrrhotite and pyrite/marcasite crusts of variable thickness. One sample (114ROV-5) is a larger piece from the trunk of the structure and is characterized by abundant pyrite, chalcopyrite and an anhydrite conduit within the pyrite crust. This seems to indicate that seafloor ingress into the structure is taking place and is channeled within the structure. Sample 114ROV-7 is a small knob of which the core consists entirely of pyrrhotite. A thin crust of pyrite and marcasite is also present.

Subsampling: SP=4C1, 4C2, 5B1, 5B2, 5G, 6, 7B; JSch=4B, 5B1, 7B; HS=5, 5C, 5bag, 6, 7.

### **Station 123ROV (dive#38):**

Sample 123ROV-4 was taken on the eastern side of the Marker 1 black smoker complex and is the outer portion of an active chimney (Tmax at this site is close 400°C). The interior of the sample consists of chalcopyrite, pyrite and anhydrite. The outer portion is composed of a 1-5 mm marcasite crust and contains a few cm wide microchimneys on top. Exterior partly oxidized to Fe-oxyhydroxides plus white bacterial-associated globules (sulfur?). Sample 123ROV-9 was sampled at the inactive Pinocchio chimney and is strongly recrystallized. Subsampling: SP=4C1, 4C2, 9/3; JSch=9/3; HS=4A, 4B.

### **Station 124GTV:**

This grab was aimed at sampling the sulfide mounds or inactive chimneys at the western flank of Turtle Pits. The target area was approached from the west and the grab was placed on top of a large sulfide boulder. Upon recovery it became evident, that this piece was a block of massive pyrite+/-marcasite with rare black sphalerite. Chalcopyrite is also rare, but slightly enriched in few samples near the interior of the sample. Ribbon texture is abundant in the outer parts of the structure indicating that this chimney was partially characterized by beehive textures. The samples have been grouped according to their texture. More massive samples belong to group 2, while samples characterized by ribbon-like layering were grouped into group 3. Accidentally recovered pieces of sheet flow basalt, representing the substrate on which the sulfide block was lying, are group 1. Subsampling: SP=2A2, 2B6, 2C3; JSch=2A3, 2B3; HS=2A6, 2B4, misc.

### **Station 130ROV (dive#40):**

Few pieces of massive sulfide were co-sampled with the bionet (130ROV-1) and consist of two types of fragments: 1. Chimney interior consisting of anhydrite and chalcopyrite. 2. Chimney crust consisting of pyrite, chalcopyrite and marcasite, partially covered by Fe-oxihydroxides. Sample 130ROV-2 is a hollow chimney structure with 2 cm thick walls of chalcopyrite and marcasite. Interior of the vent (5 x 3 x 2 cm) is lined by 1-3 mm long beautiful bladed pyrrhotite crystals up to 1 mm in diameter. Subsampling: All to SP

### **Station 139GTV:**

The station was targeted at the sulfide mound material of the Turtle Pits hydrothermal field. We approached the area from the west, passed a large boulder that was seen in some of the ROV-dives and placed the grab on the western flank of the Marker 2 mound.

The grab recovered close to 1000 kg of heterogenous sulfide-hematite-magnetite-sulfate material including small relict chimney conduit pipes (group 1), larger chimney pieces consisting of a chalcopyrite-rich interior and variably thick pyrite-marcasite rims (group 2). Sphalerite is a minor component in some of the samples as is late hematite+magnetite occurring as bladed infill in cavities and throughout some of the porous sulfides. Some of the inactive chimneys that were cosampled with the grab are dominated by massive friable chalcopyrite+/-pyrrhotite with only a thin py-mc crusts (group 3). Group 4 consist of gypsum-anhydrite-cemented samples and breccias with varying proportions of hematite, magnetite, chalcopyrite, and pyrite. Group 5 consists of very friable, soft grey material with abundant hematite+/-magnetite with associated greenish to yellow-white clay-like material (group 8). This material might well be talc, but only XRD-measurements will prove this. One primary chalcopyrite chimney is characterized by a rim of primary hydrothermal hematite-magnetite separating the interior from the pyrite-marcasite rim (group 6). Some of the anhydrite-cemented samples contain breccias of chalcopyrite conduits (mm to cm-sized) in sulfide sand that resemble conduit breccias in fossil massive sulfide deposits on land (group 7). Subsampling: SP=1A1, 2B2, 2C3, 3C3, 3D2, 3E5, 3H1, 4B2, 4C2, 4D11, 5A2, 5C3, 5D2, 5J2, 6A3, 6B2, 7B4, 7E5; JSch=2B23, 2C3, 3E5, 4D11, 5A2, 5D2; HS=2A3, 2B4, 2C2, 2E2, 2F3, 2G1, 3C1, 4A5, 4C4, 4D2, 4D7, 4G2, 4I, 5E2, 6B3, various gypsum needles.

**Station 141ROV (dive#41):**

The six pieces from sample 141ROV-6 consists of pyrite-marcasite crust with some chalcopyrite in the interior, which is typically altered (pigeon color). The redbrown outer surface is related to a thin Fe-oxihydroxide coating. One piece with central vug (2 x 3 cm) lined with pyrrhotite + isocubanite(?). Some of the fragments contain 1-3 mm layer of magnetite separating the chalcopyrite and pyrite-marcasite zones. Subsampling: All to SP.

**Red Lion area**

**Station 146ROV (dive#42):**

Two sulfide samples were recovered during the transect from Turtle Pits into the rift valley and further north to the Red Lion site. Sample 146ROV-3 is a sulfide knob from an inactive chimney on the way north with a recrystallized interior with irregular cavities lined by sphalerite and chalcopyrite (crystals <1 mm). Bulk of the piece consists of chalcopyrite-marcasite. Crust: 2 mm black Fe-oxihydroxide. One sample was recovered from the Shrimp Farm chimney at the Red Lion hydrothermal field itself. It was sampled at the edge of a large flange and immediately became a black smoker upon sampling. The sulfide contains abundant sphalerite. Internal cavity (2 x 1.5 cm) lined by pyrrhotite (+isocubanite?). A thin crust of pyrite/marcasite is extensively coated by white material (native sulfur?) and orange-brown Fe-oxides. Subsampling: SP=146-3, 146-7; HS=146-3.



Figure 1.1: Selected samples from the Turtle Pits hydrothermal field. A) Active chimney conduit with bladed pyrrhotite in the core and a rim of pyrite/marcasite (sample 130ROV-2). B) Inactive chimney knob consisting of a chalcopyrite core, a pyrrhotite-rich zone and an outer rim of pyrite/marcasite stained red by Fe-oxyhydroxides (sample 139GTV-3A). C) Porous inactive chimney composed of pyrite with a core of chalcopyrite. Multiple growth zones are visible. Late vugs are filled by black sphalerite (sample 139GTV-2F4). D) Massive pyrite cut by dense, recrystallized chalcopyrite. Fractures are lined with grey-metallic hematite-magnetite. E) Massive anhydrite/gypsum breccia with primary clasts of chalcopyrite and abundant grey hematite/magnetite. Individual conduits are lined by gypsum needles (sample 139GTV-4D6). F) Massive hematite/magnetite with relics of chalcopyrite+pyrite. This sample type is characterized by the lack of anhydrite and a clay-like alteration developed as a rim and along fractures (sample 139GTV5A3).

### **Liliput area**

During three TV-grab stations (stations 209GTV, 213GTV, and 214GTV) and one ROV dive (200ROV) hydrothermal Fe-oxyhydroxide-rich crusts were sampled from the Liliput field. During sampling and upon recovery of the TV-grab it became evident that the Fe-oxyhydroxides are water-saturated muds with only thin crusts. These crusts desintegrated on sampling. In two of the grab stations thin sheets ( $\ll 1\text{mm}$  thick) of sulfides (pyrite/marcasite?) appeared. These might be the result of biological. Subsampling: All to SP. One piece of 209GTV to CF.



Fig. 1.2: Fe-oxyhydroxide crusts from the Liliput hydrothermal field, 9°33'S (sample 209GTV-2).

### **1.4.3. ROV and OFOS deployments**

(H. Paulick, S. Petersen, K. Haase, S. Fretzdorff)

#### **Turtle Pits**

The Turtle Pits hydrothermal field is centered at 4°48.58'S / 12°22.42'W in a water depth of 2990 m and occurs within a fracture-controlled small depression. The fracture continues to the north and the south and is marked by aligned collapse pits within sheet flows. The central depression hosting the hydrothermal field is surrounded by sheet flows to the north and to the northwest, whereas jumbled flows are more exposed along the eastern side of the deposit. Turtle Pits itself consists of two mound areas (Marker 1 and Marker 2 sites) composed of sulfide debris with numerous small active black smokers at the top of the mounds (Fig.1.3) A 9.5 m high, active black smoker with vertical walls (Southern Tower) is located to the southeast of Marker 2 mound and is surrounded by a few small diameter black smoker orifice near its base. Two medium-sized inactive black smoker (Pinoccio and Stalagmite) as well as a third, more complex and somewhat older smoker, occur to the north of the active sites, where the central depression

narrows to within a few meters. Large toppled chimneys occur to the west of both the Marker 1 and Marker 2 sites, documenting previous periods of hydrothermal activity. Overall the deposit seems to be ~50 in length and up to 30 m wide. Exploration a couple 100 m to either side did not provide evidence for an extension of the deposit. Massive blocks of white (anhydrite-rich?) material are exposed along the northwestern side of the Marker 1 site. Smaller talus blocks of this material are transported into the pit to the east.

The **Red Lion** hydrothermal field lies is centered at 4°47.83'S/12°22.60'W (water depth of 3050 m) ~ 2 km north of the Turtle Pits field and consists of four active chimneys: Shrimp Farm, Zuckerhut, Mephisto, and Tannenbaum. These chimneys are between 4 and 6 m high and sit directly on a pillow lava floor. Three of the chimneys Tannenbaum, Zuckerhut, and Mephisto have a small pedestal of sulfide debris. Small (<0.5 m) inactive chimney are situated next to Shrimp's Farm and in the vicinity of Zuckerhut. Plume fallout is evident on the pillows in the immediate vicinity of the smoker. Two chimneys, Shrimp Farm and Zuckerhut are characterized by abundant shrimp responsible for the white colour of their tops. The most interesting aspect of these smokers is their flange growth, not commonly reported from seafloor hydrothermal systems. The conductive cooling of the hydrothermal fluids through the flanges supports a thriving community of shrimp on these two structures. The other two chimneys do not show evidence for flange growth and shrimp are rare.

The distance between these two sites (Turtle Pits and Red Lion) may give evidence for the size of the individual hydrothermal convection cells in the area and provides a tool for the exploration of further sites in similar distance to those two hydrothermal field. This is supported by the discovery of small inactive sulfide deposits in the SW of the deposits suggesting, at least, a potential for additional vent sites in the area.

In addition to detailed investigations of the hydrothermal fields at 4°48'S, several ROV deployments were designed to investigate the volcanic geology of the MAR in detail (eruption-scale). The areas investigated are:

- a) the neovolcanic zone between 4°47.76'S (Red Lion) and 4°48.90'S,
- b) a „young“ on-axis volcanic center at 8°40'S to 8°50'S (segment A2),
- c) the surrounding of the Liliput hydrothermal field (9°33'S), and
- d) on-axis and off-axis volcanic fields in the central A3 segment (9°34.40'S and 9°42.50'S).

Geological maps of these tracks are presented in Fig. 1.4 and in the following the principal observations are summarized.



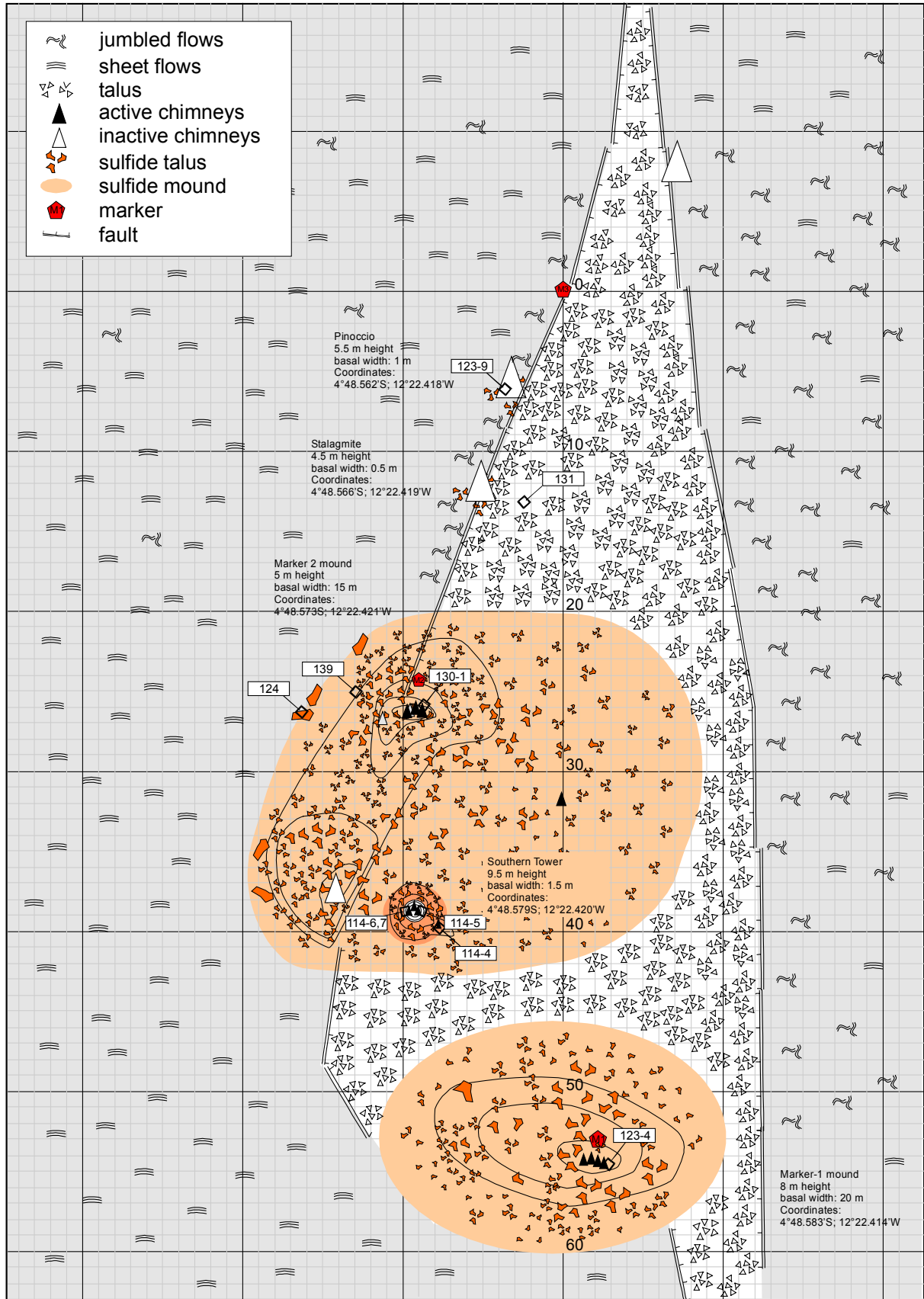


Fig. 1.3: Relative location of individual chimneys and mounds and geology around the Turtle Pits hydrothermal field, 4°48.58'S/12°22.42'W. Grid is 10 m.

### **Neovolcanic zone between 4°47.76'S (Red Lion) and 4°48.90'S**

ROV dive 42 (station 146) transgressed ca. 800 m of the neovolcanic MAR at 4°48.90'S which consists mainly of fresh sheet flows including areas with jumbled and lobate flow textures. In contrast, a pillow mound (ca. 30 m high; radius >600 m) in the central portion of this MAR segment is heavily sedimented and locally dissected by tectonic faults indicating a relatively high age. To the north, the neovolcanic zone deepens significantly from 3005 m at 4°48.70'S to 3053 m at 4°47.80'S. Most of this area is dominated by fresh (no sediment cover) jumbled to lobate sheet flows, however, pillow lavas become increasingly abundant to the north. On these pillow flows an inactive black smoker chimney is located at 4°47.90'S and about 200 m further north the active black smokers of the Red Lion hydrothermal field were discovered.

### **On-axis volcanic center at 8°40'S to 8°50'S (A2 segment)**

A relatively young volcanic center was identified in this area of the MAR (segment A2) during Meteor Cruise M62-5 based on side scan images which show highly reflective surfaces undisturbed by tectonic faulting and lineaments defined by coalesced volcanic edifices. The highly reflective surfaces have been interpreted as extensive young lava flows (sheet flows?) fed by voluminous fissure eruptions. Two ROV deployments (dive 43, station 155 and dive 44, station 159) were designed to ground truth these interpretations and obtain eruption scale samples of the basalts.

A 1500 m long transect started in the tectonized western margin of the MAR that consists of pillow basalt and talus breccia. The neovolcanic zone is ca. 900 m wide and characterized by sedimented pillow and lobate flows. The lobate flows are largely restricted to a 350 m wide area that rises by about 20 to 30 m above the surrounding pillow basalts and contact relationships indicate that this structure represents the youngest volcanic eruption. To the east, the terrain is characterized by abundant N-S trending tectonic faults marking the margin of the neovolcanic zone. The basalts sampled during this dive are aphyric to poorly olivine-phyric, providing little petrographic evidence for distinguishing the products of individual eruptions.

To the north, a ca. 1600 m portion of the neovolcanic zone has been investigated during dive 44 (station 159) which crossed a 400 m wide and 50 m high pillow mound. This mound consists of highly plagioclase-phyric basalt (10 vol% plagioclase phenocrysts up to 10 mm) and is covered by a thick blanket of white pelagic sediment that includes local patches of pteropoda shill. Furthermore, colonization by Gorgonaria is also prevalent. In contrast, the aphyric to poorly porphyritic basalt lava flows to the north and south of the pillow mound show only minor biological colonization and variable degrees of sedimentary cover suggesting a younger age. However, contact relationships at the base of the pillow mound are inconclusive in this regard.

Overall, the volcanic plain surrounding the pillow mound is dominated by lobate and ropy sheet flow morphologies including minor intervals with jumbled textures. About 500 m to the north of the mound, a pillow lava flow lacking a sedimentary cover is overlying a jumbled sheet flow. This pillow flow may represent the youngest volcanic eruption in the area.

### **Liliput hydrothermal field (9°33'S) and on-axis exploration (9°31.0'S to 9°33.20'S)**

The Liliput hydrothermal field was discovered during ROV dive 47 (Station 200), which was targeted based on CH<sub>4</sub> anomalies in the water column. It consists of abundant, semi-lithified Fe-oxihydroxide accumulations over an area of some 100x40m and mussel colonies at 1495 m



water depth that form linear and patchy arrangements following pre-existing cracks and contacts in the underlying basalt pillows. Venting of warm hydrothermal fluids has been observed where cracks within individual pillows and intrapillow space provide primary permeability. Temperatures measured with the sensors mounted on the ROV at a distance of ca. 0.5 m from the vent sites peaked at 5.1 °C.

The Liliput hydrothermal field (9°32.85'S; 13°12.54'W) is located in the central zone of the neovolcanic MAR. The surrounding area is characterized by fresh, aphyric basalt pillow flows. To the west, there are abundant N-S trending escarpments flanking horst and graben structures. A strongly sedimented pillow mound with abundant Gorgonaria and other biological colonization marks the westernmost location visited during Station 200.

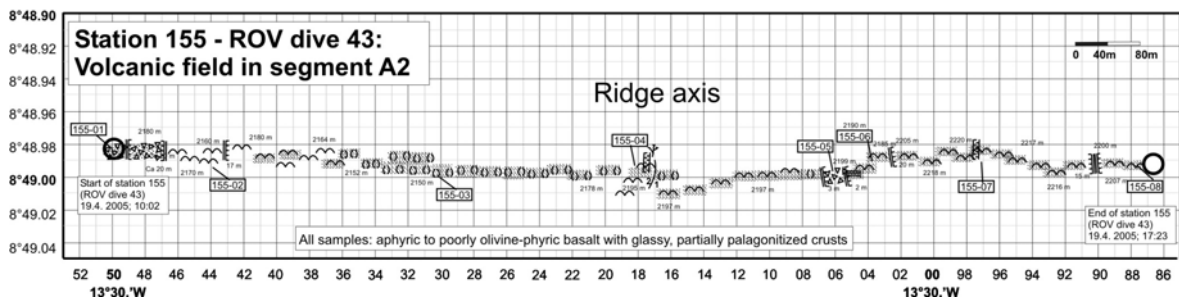
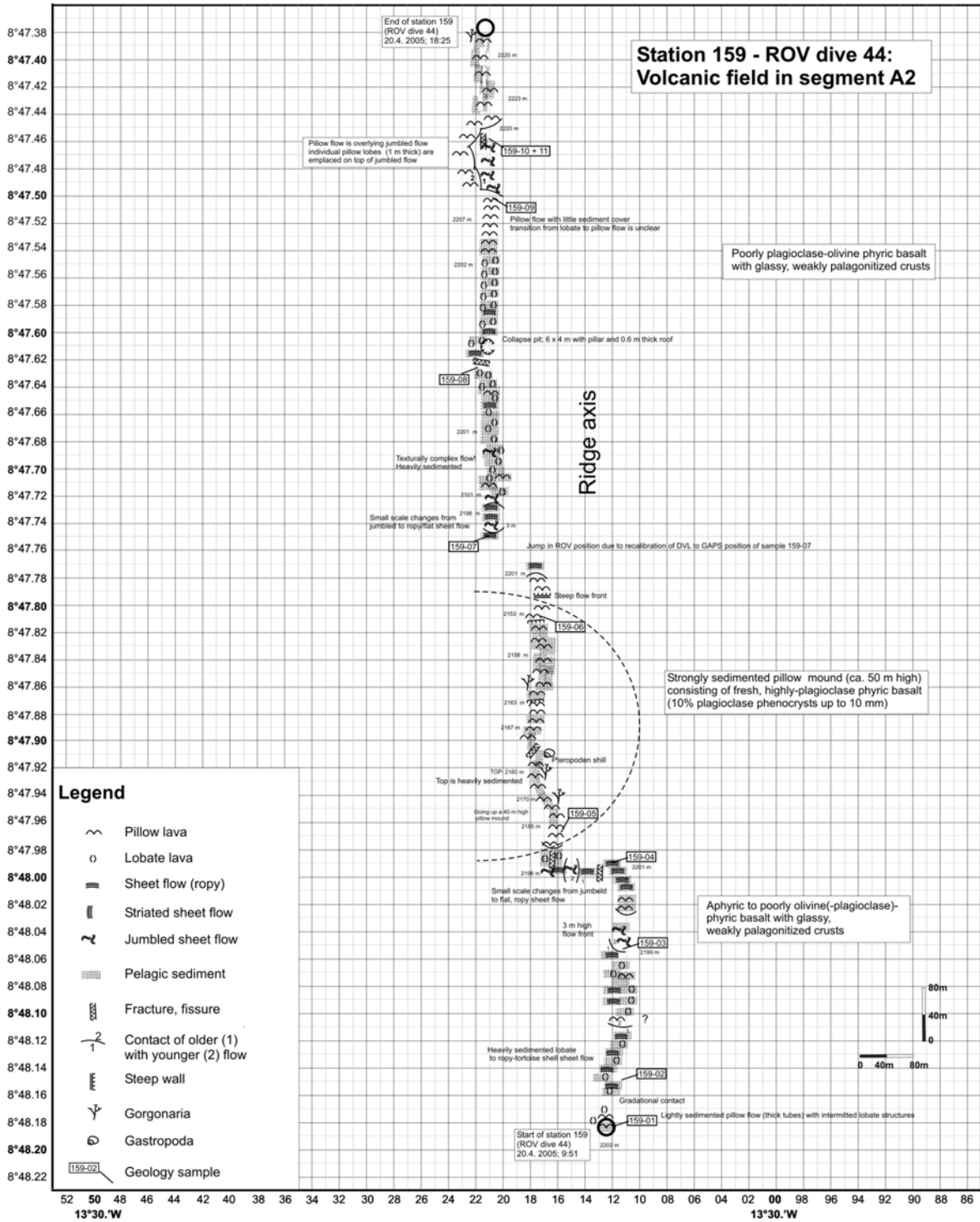
The OFOS track of Station 215 was designed to investigate the neovolcanic zone between 9°31.00'S and 9°33.22'S, an area where substantial CH<sub>4</sub> anomalies have been detected in the water column. In total, 800 images of the seafloor were taken at regular intervals of ca. 30 seconds and a CDT was mounted on the sledge. The entire area to the north of the Liliput field is dominated by pillow lavas with variable sediment cover and locally abundant cliffs and fissures marking the tectonized western margin of the neovolcanic zone. To the south of the Liliput field (9°33.00'S to 9°33.22'S) there are fresh pillow basalts and abundant mussels and light gray mats of hydrothermal (?) sediment were discovered at 9°33.20'S / 13°12.51'W (position of Meteor, cable length exceeds water depth by 20 m). This area may be the extension of the Liliput field along a N-S oriented lineament and represents an important target for further hydrothermal exploration.

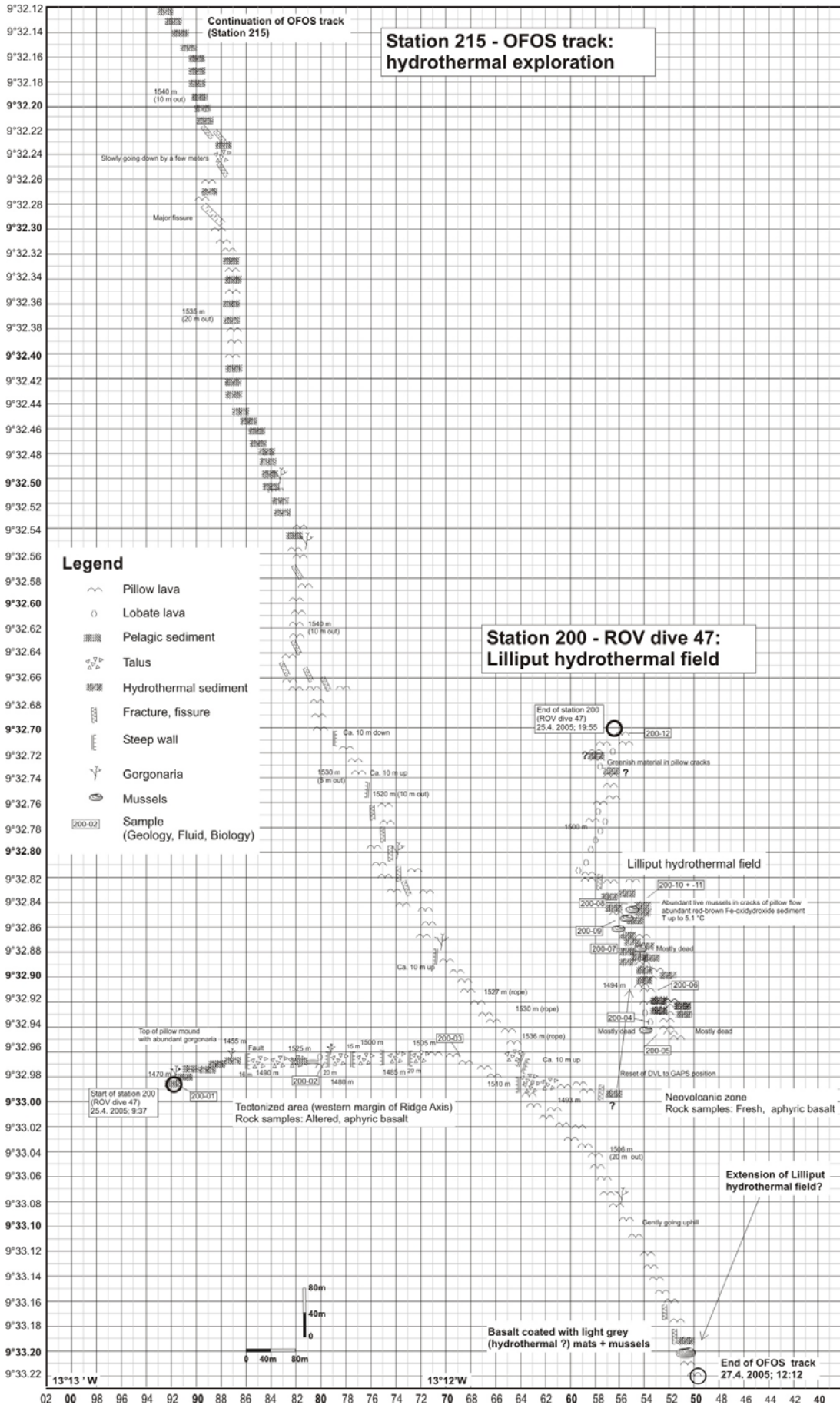
### **On-axis and off-axis volcanic fields at 9°34.40'S and 9°42.50'S (A3 segment)**

The central portion of the MAR between the Ascension and Bode Verde Fracture Zones (segment A3) is characterized by shallow water depths (reaching depths <1400 m), the absence of a deep central valley, and numerous off-axis volcanoes concentrated in an area to the east of the MAR (including Grattan Seamount). Two dives were targeted at investigating and sampling the on-axis neovolcanic zone (dive 46, Station 194) and the off-axis volcanic fields (dive 45, Station 188).

The neovolcanic zone at 9°34.38'S consists of about equal proportions of pillow flows and lobate to ropy sheet flows with prominent collapse structures. The basalts are aphyric and biological colonization is rare. The western flank of the active MAR at 13°13.70'W is marked by prominent N-S trending cliffs and the highest point in this area (1427 m) is ca. 50 m above the center of the neovolcanic zone (1470 m). This marginal zone consists exclusively of aphyric pillow basalts with abundant Gorgonaria and other fauna. The glass crusts of these basalts are extensively palagonitized and Mn-oxide/Fe-oxihydroxide coating is common. These observations indicate that the basalts on the western flank are older than the basalts in the neovolcanic zone. The off-axis volcanic fields have been studied at 9°42.50'S in an area located ca. 10 km to the east of the central MAR. Here, 20 to 30 m high pillow mounds are surrounded by extensive plains of white pelagic sediments (foraminiferous ooze) with localized and isolated outcrops of individual pillows and pillow ridges. Furthermore, there are tectonic escarpments with associated talus breccia. The aphyric to poorly porphyritic basalts show extensive palagonitization and coating by Mn-oxides and Fe-oxihydroxides, which, together with the locally abundant biological colonization, indicates that the volcanic activity is relatively old.







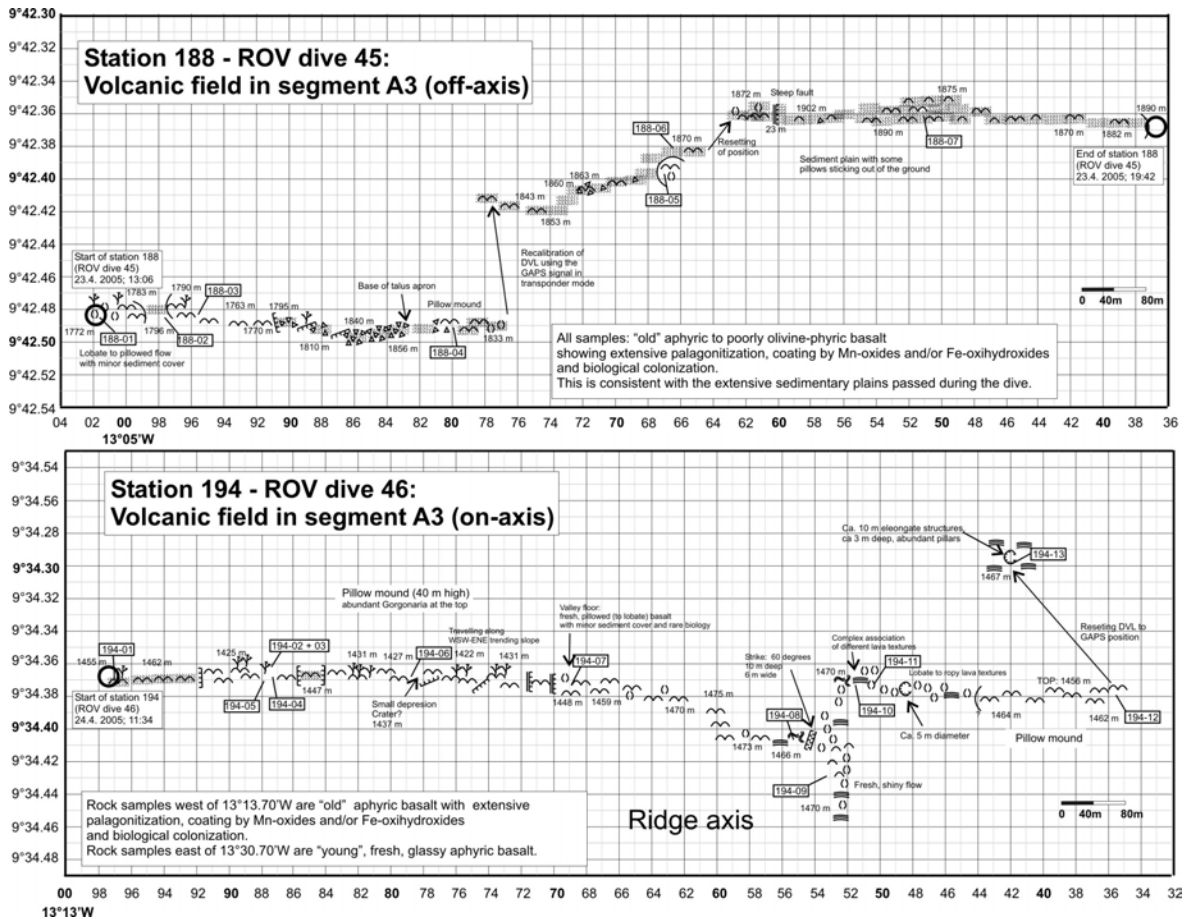


Fig. 1.4: Geology along ROV and OFOS tracks

#### 1.4.4. Fluid Chemistry

(A. Koschinsky, H. Marbler, C. Ostertag-Henning, H. Strauss, U. Westernströer)

Hydrothermal fluids are characterized by their unique chemical and isotopic composition, which is significantly different from ambient seawater (e.g., van Damm, 2004). Scientific objectives for fluid chemical analyses, both on-board and subsequently in the home laboratories, include the detection of hydrothermal plumes in the water column and a quantification of the chemical and isotopic composition of hydrothermal fluids discharging from the ocean crust via distinct vent sites (either through black smokers or diffuse venting).

Three different types of samples were collected for chemical and isotopic analyses: water column samples from the CTD/Rosette, equipped with 24 bottles à 10 l volume; samples from discharging vent sites collected with three Niskin flasks (5 l volume), mounted at the front of the MARUM ROV QUEST; vent fluid samples collected with the new Kiel Pumping System (KIPS: 15 bottles à 675 ml) by inserting a titanium sampling nozzle into the orifice of smoker structures.



#### 1.4.4.1. Fluid Sampling System for MARUM ROV QUEST

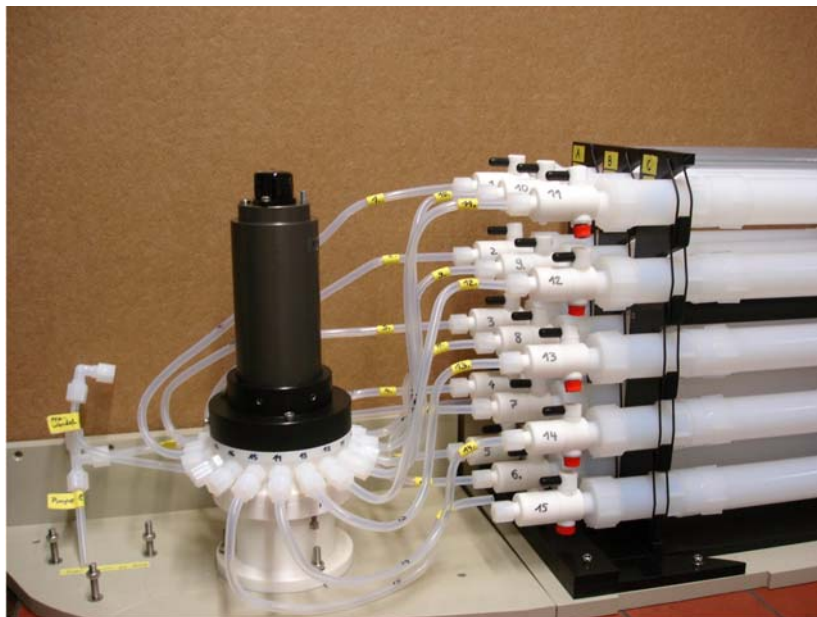
For sampling of hydrothermal fluids directly at the vent sites, a pumped flow-through system (Kiel Pumping System, KIPS) mounted on the ROV's starboard back side (Fig. 1.5) was used.



**Fig. 1.5:** The fluid sampling system “KIPS” mounted on the starboard back side of the Bremen MARUM ROV (“Quest”) tool sled

The system was newly constructed and entirely made of inert materials (Teflon, titanium). Samples are collected via a titanium nozzle of 50 cm length which can be directly inserted into the vent orifice by the ROV's manipulator arm. Parallel to the nozzle is a high-temperature probe measuring the *in situ*-sampling temperature. PFA tubing connects the nozzle to a 18 position-multiport valve motorized by a ROV actuator (SCHILLING, U.S.A) (Fig 1.6). The valve distributes the sample to max 15 individual PFA Teflon flasks with 675 ml volume each. Each bottle is equipped with all-Teflon checkvalves at inlet and outlet. All sample bottles are mounted in three racks A, B, C, with every rack containing five horizontally positioned bottles. For sub-sampling the three racks were transferred to the laboratory. A deep sea pump is mounted downstream to the sample bottles. The system is fully remotely controlled via the ROV control desk.

The system is modular in such a way that a number of bottles can be filled separately or interconnected in-line according to the needs of both sample volume and number of samples (c.f., leg M64/2). During leg M64/1 five sample flasks were filled at every sampling location, thus, resulting in sufficient fluid volume (3.4 l) in order to study all aspects of fluid chemistry and dissolved gas composition on sub-samples that are as identical as possible. The bottles were pre-filled with freshwater or seawater. To assure the complete exchange of pre-filled water with sample fluid the total pumping time for 5 in-line bottles was determined experimentally. A total pumping time of 1 hour was applied during the cruise.



**Fig. 1.6:** Details of the Kiel fluid sampling system showing actuator-driven PETP multiport valve (left) and PFA tubing to 15 PFA Teflon sampling flasks in 3 racks A, B, C

#### 1.4.4.2. Fluid Sampling and Sample Preparation

##### Water Column Samples

Based on the depth profiles for temperature, salinity and light transmission, samples were collected at different depths with the CTD/Rosette system, covering the vertical distribution of the hydrothermal plume. Sampling of these waters was performed directly after recovery of the CTD/Rosette system.

Immediately after sampling, pH and Eh were measured. Subsequently, and depending upon future chemical analyses, non-filtered subsamples (with aliquots either non-acidified or acidified to a pH of 2 with suprapure HCl) were stored at 4°C.

Barium sulphate was precipitated from sample aliquots (addition of barium chloride solution at pH 2) for measuring the sulphur and oxygen isotopic compositions of dissolved sulphate. For selected CTD stations, untreated water samples were collected for measuring the oxygen and hydrogen isotopic composition of these waters.

For the CTD stations in the vicinity of the Turtle Pits, Wideawake Mussel Field and Red Lion hydrothermal fields, samples throughout the water column have been collected for the analysis of amino acids in the dissolved and particulate organic material. Water samples were filtered through GF/F glass fibre filters and the filters wrapped in aluminium foil and frozen at -20°C. The organic compounds in the filtrate were concentrated by means of solid phase extraction onto C18 and SCX phases and subsequently stored at -20°C. For selected profiles throughout the water column an aliquot of the samples has been frozen at -20°C for later analysis of the ammonium concentration and its nitrogen isotopic composition.

## Vent Fluid Samples

Immediately after recovery of the ROV, all three Niskin flasks (N1, N2, N3) and all bottles from the KIPS were sub-sampled. On small aliquots (20 ml), pH and Eh were measured directly after sampling for all samples.

Aliquots were sub-sampled for the following chemical and isotopic analyses: major and trace elements, selected anions, methane and hydrogen (abundance and isotopic composition), sulphate and sulphide sulphur isotope geochemistry, dissolved inorganic carbon (abundance and isotopic composition), amino acids, ammonium (abundance and nitrogen isotopes).

Unfiltered sample aliquots were collected for gas chemistry, for analyses of dissolved sulphide, for dissolved inorganic carbon, for amino acid analyses, and for ammonium measurements. Similarly, unfiltered water was sub-sampled for microbiological work.

For all other chemical analyses, fluid samples were pressure-filtrated with Nitrogen (99.999%) at 0.5 bar through pre-cleaned 0.2 µm Nuclepore PC membrane filters by means of polycarbonate filtration units (Sartorius, Germany). The filtrates were separated into aliquots for voltammetric and ICP analyses and acidified to pH 1 with 100 µl subboiled concentrated nitric acid per 50 ml (ICP) and with suprapure HCl to pH 2 (voltammetry), respectively. For selected samples, about 150 ml of fluid were filled into specially pre-cleaned bottles and immediately deep-frozen at -20°C. These samples are shipped in frozen state for the determination of organic metal complexation in the home laboratory of the project partner Dr. Sylvia Sander (University of Otago, New Zealand). Some representative samples were deep-frozen or poisoned with HgCl<sub>2</sub>, respectively, as conservation for organic analyses in the home laboratory.

Procedural blanks were processed in regular intervals. All work was done in a class 100 clean bench (Slee, Germany) using only all-plastic labware (polypropylene, polycarbonate, PFAteflon). Rinse water was ultrapure (>18.2 Mohm), dispensed from a Millipore Milli-Q system.

A total of 227 water column samples, 26 bottle samples from the fluid sampling system, and 17 Niskin samples were collected. After return to the home labs, in Kiel selected samples will be analysed for major (Mg, Ca, Ba, Sr, Na, K, Si, Fe, Mn, B, Cl) and trace element composition (e.g., I, Br, Li, Al, Cs, Ba, Sr, Y-REE, Fe, Mn, Cr, V, Cu, Co, Ni, Pb, U, Mo, As, Sb, W, PGE) by ICP-OES (Spectro Ciros SOP CCD) and ICP-MS using both collision-cell quadrupole (Agilent 7500cs) and high-resolution sector-field based instrumentation (Micromass PlasmaTrace2).

At IUB in Bremen, voltammetry will be used for further trace metal analyses (Zn, Cd, Pb, Cu, Co, Ni, Ti, V, Mo, U, Tl, Pt). ICP-MS and ICP-OES measurements of minor elements and trace metals (see above) will be carried out as well for interlaboratory comparison. Li and Na will be analysed by flame photometry, and photometric methods will be used to determine anionic compounds (silicate, phosphate, sulfate, chloride). The duplicate coverage of some elements with different methods will be used for the evaluation of the methods and the data. The determination of organic complexation of Fe, Cu, and Zn (S. Sander, Univ. Otago) will be done by voltammetric ligand titration.

At the Westfälische Wilhelms-Universität Münster, sulphur (sulphides, sulphates), oxygen (sulphates, fluid samples), and hydrogen (fluid samples) isotope measurements will be performed.



At the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) in Hannover the amino acid concentrations (HPLC-FD) and their racemization (GC-FID) as well as their isotopic composition (GC-irmMS) will be analysed for selected samples. Additionally, the ammonium concentration and its nitrogen isotopic composition will be investigated. For a set of samples the concentration and carbon isotopic composition of the dissolved inorganic carbon will be analysed by a Finnigan Gasbench-Delta Plus-MS coupling.

#### **1.4.4.3. On-board analyses**

##### **pH and Eh Measurements**

For all samples collected with the CTD/Rosette, the Niskin flasks and the Kiel Fluid Pumping System, pH and Eh measurements were performed on unfiltered sample aliquots immediately after sampling. Measurements were carried out with WTW electrodes (Ag/AgCl reference electrode).

##### **Chloride Titration**

In order to determine whether or not phase separation affected the chemical composition of the hydrothermal fluids, respective fluid samples collected during ROV dives, either with Niskin bottles or with the Kiel Fluid Sampling System, were subjected to chloride concentration analysis. Measurements were performed as titration with 0.1 mM AgNO<sub>3</sub>-solution, using fluoresceine-sodium as the indicator. For reference, samples from a water column profile were also analyzed.

##### **Photometric Determination of Dissolved Inorganic Silica**

Silica tends to be enriched in hydrothermal fluids (e.g., van Damm, 2004). Hence, fluid samples and selected CTD/Rosette water column samples were analyzed for their abundance of dissolved silica. The analysis of dissolved silicon compounds in seawater and hydrothermal fluids is based on the formation of  $\alpha$ -silicomolybdic acid via complexation of the dissolved silica with ammoniumheptamolybdate (e.g., Grasshoff et al., 1999). Concentration measurements were performed with a biochrom Libra S12 spectral photometer at an extinction of 810 nm. Silica contents in water column samples were measured both in filtered and non-filtered samples. No significant difference was detected.

##### **Photometric Determination of Iron Concentrations**

The principle of this method is the determination of an orange-red ferrioxal complex, which is formed by Fe(II) ions in the fluid sample with 1,10-phenantroline in a pH range of 3-5. In addition to a quantification of Fe(II), it is also possible to measure the Fe<sub>tot</sub> fraction in the sample by reducing all Fe with ascorbic acid. Fe(III) is determined as difference between Fe<sub>tot</sub> and Fe(II). Analyses were carried out with a biochrom Libra S12 spectral photometer and the absorption was measured at 511 nm. Fe concentrations were measured only in filtered samples of hydrothermal fluids. The detection limit is about 0.1 ppm. Samples with concentrations above 100 ppm were measured in diluted samples.

##### **Voltammetric Determination of Trace Element Concentrations**

For onboard sulfide and trace metal concentration analyses, the electrochemical method of voltammetry was used. Voltammetry is able to differentiate between different redox species and (in combination with UV digestion of the water samples) free and complexed forms of ions in

solution and is highly sensitive. All the voltammetric measurements were performed using a Metrohm system comprising a 757 VA Computrace run with a standard PC, an 813 Compact Autosampler and two 765 Dosimats. The three-electrode configuration consisted of the multi-mode electrode (MME) as the working electrode, an Ag/AgCl reference electrode ( $3 \text{ mol l}^{-1}$  KCl), and a platinum wire as the auxiliary electrode.

Immediately after recovery, the unfiltered fluid samples were analysed for total dissolved sulfide in alkaline solution using the method after Metrohm Application Bulletin 199/3e. Filtered aliquots were submitted to a digestion process in a UV Digestor (Model 705, Metrohm), which contains a high pressure mercury lamp (500 W), decomposing organic metal complexes. After 1 hour UV irradiation, the total content of Fe and Mn in all samples and of Zn, Cu, Cd, and Pb in selected samples were determined by the standard addition method. For Fe, the highly sensitive cathodic stripping voltammetric method of Obata and van den Berg (2001) using 2,3-dihydroxynaphthalene as complexing agent was applied in samples with low Fe concentrations, while photometry was used for samples with high Fe concentrations ( $>0.1 \text{ ppm}$ ). Mn concentrations were determined using anodic stripping voltammetry in an alkaline ammonia buffer solution (Locatelle and Torsi, 2001). For Cu, Pb, Cd, and Zn analyses samples were buffered at pH 4.6 with 1 M acetate buffer solution and measured by ASV (Application Bulletin Metrohm 231/2).

#### **1.4.4.4. Results from On-Board Analyses**

##### **Vent Fluids**

The chemical and isotopic characterization of hydrothermal vent fluids is strongly dependent upon the sampling procedure. Dilution with ambient seawater is always likely. In order to qualitatively assess the contribution from seawater, a number of analytical parameters, such as Eh, chloride have been measured on-board. A final quantification of the fluid contribution from a hydrothermal source will be performed by using Mg concentrations (hydrothermal endmember Mg = 0, seawater endmember Mg = 55 mM). These will be measured in the home laboratory.

The pH and Eh measurements for the samples collected directly at the vent sites during ROV deployments clearly reflect the mixture of hot reducing hydrothermal endmember fluid and oxic seawater. Lowest values for the hydrothermally purest samples were 3.83 for pH and  $-260 \text{ mV}$  for Eh. A crossplot of respective data (Fig. 1.7) allows a clear distinction between hydrothermal fluid and seawater. Most extreme values have been measured for samples from the Turtle Pits area (ROV stations 141 and 146). Results obtained from Niskin flask samples are somewhat in between both endmembers, i.e. reducing hydrothermal fluid and oxidized seawater.

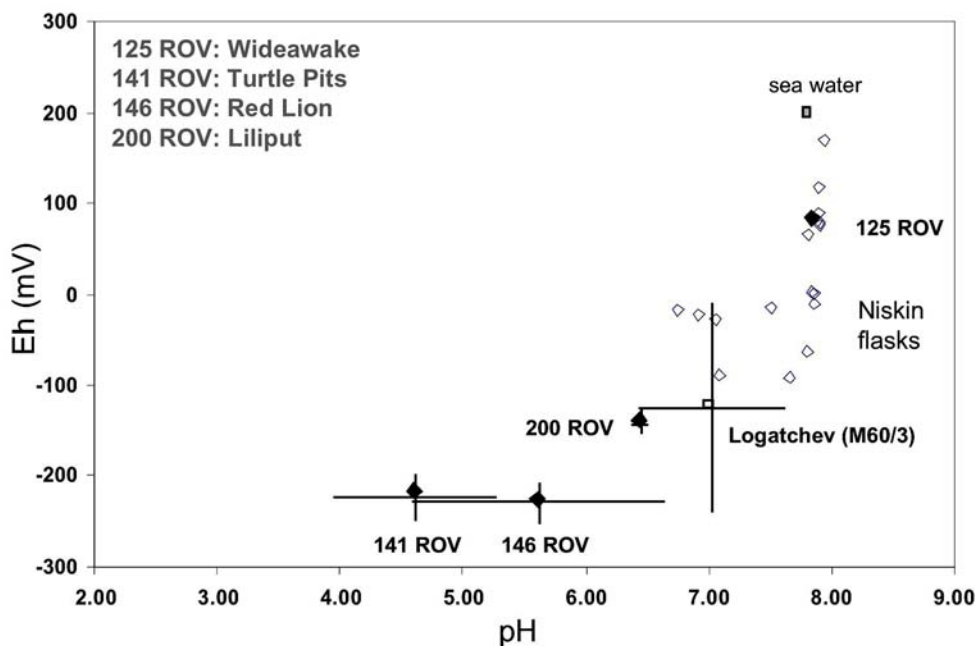


Fig. 1.7. Crossplot of pH and Eh for fluid samples from Niskin flasks and KIPS bottles

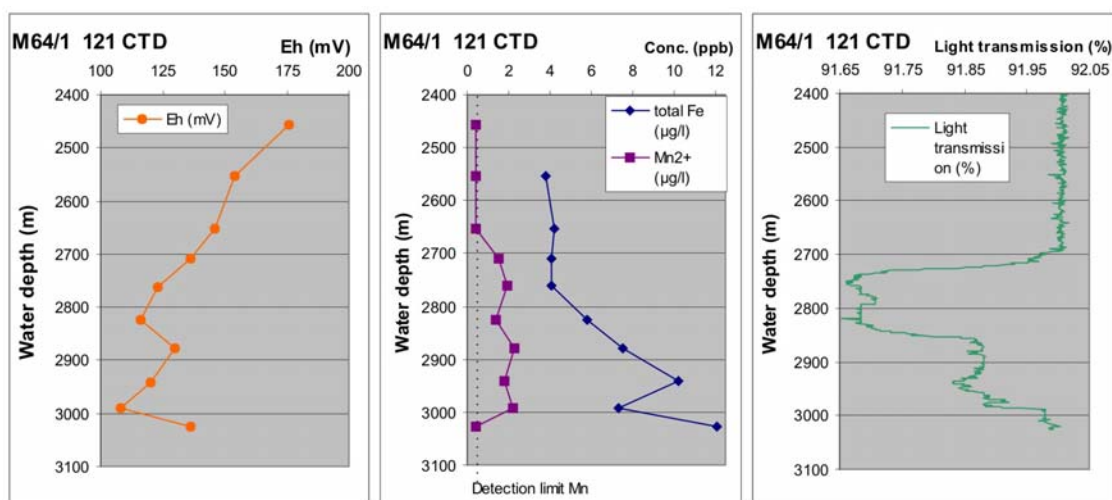
Measured sulfide concentrations were less than 1 mg/L in all samples, which may be partly due to the loss of free sulfide through Fe sulfide precipitation during cooling of the hydrothermal fluids. Chloride titrations indicated that the hot vents from the Turtle Pits field have significantly reduced chloride concentrations (minimum value at 13.52 mg/L) compared to a background seawater value of 21.0 mg/L. This clearly indicates that the fluids are phase-separated and that the samples represent the vapor-type phase. Silica is up to 200fold enriched over an average seawater concentration of about 1 mg/L. Si enrichment is typical for hot hydrothermal fluids (as exemplified by samples from ROV stations 141 and 146) due to intensive water-rock interaction. The same applies to Fe and Mn, having highest concentrations of dissolved total Fe of up to 105 mg/L, of which more than 80 % were found to be Fe(II), and up to 0.9 mg/L Mn. It has to be noted that the endmember concentration of Fe, including all Fe bound in the sulfide particles, is significantly higher, but can only be determined later in the home laboratory. Very low concentrations of dissolved Zn (max. 30  $\mu\text{g/L}$ ), Cu (max. 7  $\mu\text{g/L}$ ), Pb, and Cd were detected, indicating that most of these chalcophilic elements, which are typically enriched in hydrothermal fluids, are strongly bound into the precipitating sulfide particles, parallel to Fe.

Diffuse vent fluids collected from the Liliput hydrothermal field at 9°33'S are characterized by moderate enrichment of elements that were found to be high in the hot fluids, confirming their mixed fluid – seawater character. They were also significantly reducing (Eh of -137 mV) with slightly lowered pH (6.5).

### Water Column Profiles

As Eh measurements are a fast and relatively simple analytical tool, they were used as the first measurement following the recovery of CTD water column samples in order to search for hydrothermal plume indications. For several stations, Eh minima clearly correlate with maxima of other hydrothermal tracers analysed, such as methane, hydrogen, Mn, and Fe concentrations (Fig. 1.8). However, especially when the plume signals were not very pronounced, Eh anomalies

were less pronounced or absent. Mn and Fe, were both detected in concentrations significantly above ambient seawater background in samples with very high methane and hydrogen concentrations and from the depth range with high turbidity values. In contrast, respective enrichments could not be detected in samples with lower gas concentrations. This observation can be used as an indicator for the proximity of the source, because the  $\text{CH}_4/\text{Mn}$  or  $\text{CH}_4/\text{Fe}$  ratios typically increase away from the plume due to metal oxidation and particle fallout. As Fe and Mn were determined in unfiltered samples, the data represent total dissolvable concentrations.



**Fig. 1.8** Water column profiles of hydrothermal tracers, indicating the existence of a hydrothermal plume between 2700 and 3000 m water depth at 5°S

#### 1.4.5. Dissolved Gases and Carbon Species

(R. Seifert, S. Weber, M. Warmuth)

##### 1.4.5.1. Introduction

Objective of the work during M64/1 was to localise and characterise hydrothermal fluids and plumes using *in situ* sensors (CTD with sensors for redox and light transmission) and applying on board analytical techniques to determine concentrations of dissolved reactive gases ( $\text{CH}_4$ ,  $\text{H}_2$ ). To elucidate the transformation of carbon species and reduced gases brought along by hydrothermal fluids, a comprehensive set of samples was secured for on shore analysis of stable isotope contributions (H, C, He) of fluid components. Subjects of the study were hydrothermal fluids and plumes of two areas along the MAR - Red Lion / Turtle Pits / Wideawake (04°48'S), and the Liliput hydrothermal field (9°30'S) with the latter discovered during this cruise.

For this purpose 39 stations were covered by CTD/Rosette and a total of 252 water samples were obtained from these CTD stations and 6 ROV stations.

##### 1.4.5.2. Samples and Methodology

CTD data were recorded using a SEABIRD CTD Type 911 equipped with a Eh sensor (AMT series 40) and a sensor for light transmission as well as a rosette of 24 10L Niskin bottles. Water

samples were taken during lifting keeping the sampler at a certain depth for a short time. A total of 39 stations were performed of which only did failed to yield data. At 107 CTD malfunction of the temperature sensor occurred at about 1100m water depth caused by seawater entrance at the connection to the data transfer unit. The problem could easily be solved. Data of station 129 CTD were lost by a problem with data recording system on deck. For all other stations data could be recorded and saved for the entire water column.

*Light dissolved hydrocarbons* were analysed on board applying a purge and trap technique (Seifert et al., 1991). The water sample is stripped by He and analyses in the outflowing gas stream are concentrated in cooled traps at  $-84^{\circ}\text{C}$ . After degassing, the trapped gases are released to a gaschromatograph (CARLO ERBA GC 6000) equipped with a packed (activated  $\text{Al}_2\text{O}_3$ ) stainless steel column and a flame ionisation detector (FID) to separate, detect and quantify individual components. Recording and calculation of results is performed using a PC operated integration system (BRUKER Chrom Star). Analytical procedures were calibrated daily with commercial gas standards (LINDE). Analyses were generally done within 12 hrs after sampling.

For on board *measurements of dissolved hydrogen* up to 615ml of sample is connected to a high grade vacuum in an ultrasonic bath and heated until boiling. Aliquots of the released gas are transferred via a septum from the degassing unit into the analytical system. A gaschromatograph (THERMO TRACE) equipped with a packed stainless steel column (Molecular sieve 5A, carrier gas: He) and a pulsed discharge detector (PDD) is used to separate, detect and quantify Hydrogen. Recording and calculation of results is performed using a PC operated integration system (THERMO CHROM CARD A/D). Analytical procedures were calibrated daily with commercial gas standard (LINDE).

For on shore measurements of the *He concentrations and isotopic signature*, water samples were taken immediately after finishing the respective station. The samples were sealed head space free and gastight in copper tubes. Measurements will be performed at the Universität Bremen, Fachbereich 1 (Tracer Oceanography).

Samples for the determination of  $\delta^{13}\text{C}$  of the *dissolved light hydrocarbons* were obtained by degassing the water samples with a vacuum - ultrasonic technique (see above). Aliquots of the released gas were transferred via a septum from the degassing unit into gastight glass ampoules filled with NaCl-saturated water for on shore analysis by GC-Isotope-Ratio-Mass-Spectrometry.

For on shore analysis of *stable carbon isotopes of dissolved inorganic carbon (DIC)*, aliquots of unfiltered sample was spiked with NaOH and  $\text{BaCl}_2$  directly after recovery to precipitate carbonate species. The analyses of  $\delta^{13}\text{C}$ -DIC will be made by Dual-Inlet-Isotope-Ratio Mass-Spectrometry (THERMO MAT 252).

For on shore analysis of *stable isotopes for dissolved hydrogen*, up to 10mL of gas obtained by vacuum/ultrasonic degassing of sample was frozen on molecular sieve 4A under liquid nitrogen in a pre-vacuated glass vial. The samples will be analysed via a molecular sieve 5A PLOT column and a GC-Isotope-Ratio-Mass-Spectrometer for  $\delta^2\text{H}$ -values.

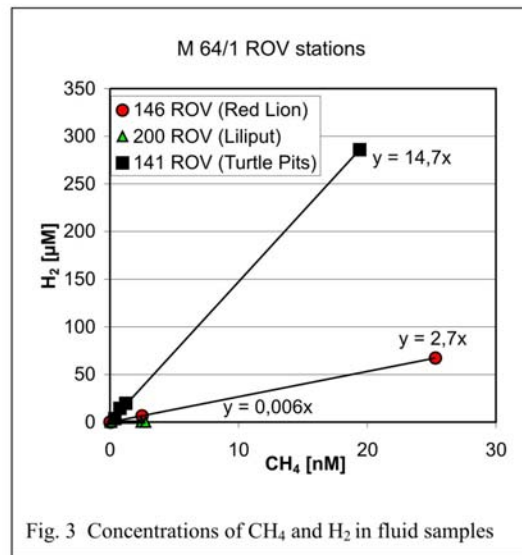
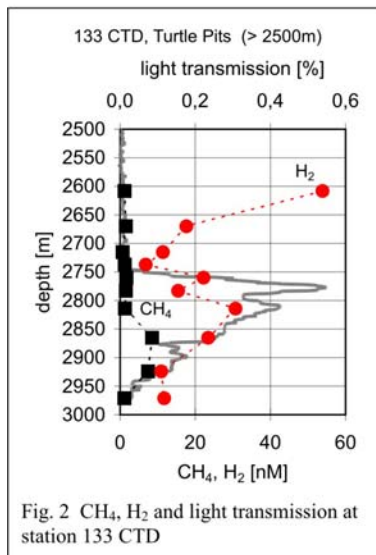
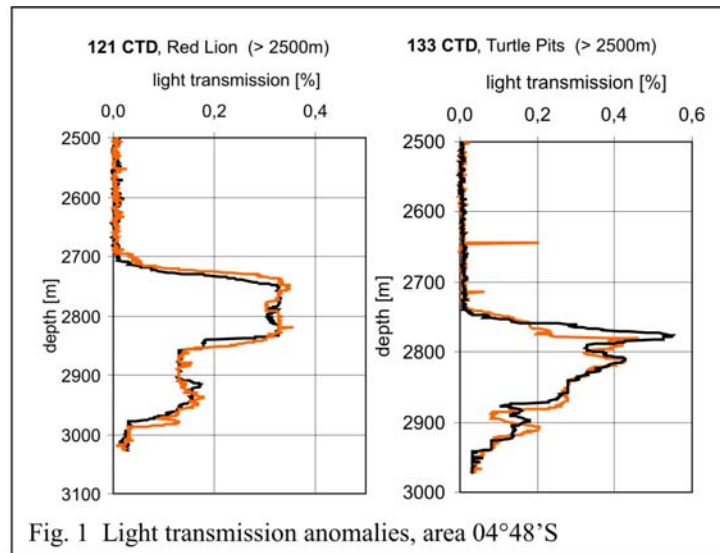
To obtain an overview on the organic components contained in the hydrothermal fluids, selected samples were treated by Solid Phase Extraction (SPE).

### 1.4.5.3. Results

For the first working area (Turtle Pits, Red Lion, Wideawake) Most CTD profiles obtained in revealed imprints of hydrothermal activity within the water column by anomalies in the transmission profiles and ST diagrams (salinity versus potential temperature). These anomalies were present at a water depth range from 2700 to 3000m (Fig. 1). The S/T plots evidence the intrusion of a component relatively depleted in salinity.

Results for concentrations of dissolved methane and hydrogen obtained from CTD/rosette samples on board RV METEOR revealed hydrothermal signatures within the same depth range but do not correlate well with each other and the observed light transmission anomalies (Fig. 2).

Samples obtained by ROV directly at the fluid emanations revealed very high concentrations of dissolved hydrogen and Methane. Maximum concentrations found accounted for 0.29 mmol L<sup>-1</sup> and 0.02 mmol L<sup>-1</sup> of hydrogen and methane, respectively. The sample was obtained by putting the tip of the fluid sampling system directly into the outlet a black smoker vigorously exhaling boiling fluid (Station 41 ROV; Turtle Pits). The resulting H<sub>2</sub>/CH<sub>4</sub> ratio of about 14.7 (Fig. 3), that is also found in water samples taken by ROV-based Niskin bottles in the vicinity of the smoker, even exceeds those we found for fluids of the Logachev field (see Table 1.2). A higher ratio is so far only reported for fluids obtained at the EPR at 21°N (Welhan & Craig, 1979). A fluid sample recovered from a black smoker within the Red Lion hydrothermal field (146 ROV) revealed H<sub>2</sub>/CH<sub>4</sub> ratio of about 3 with concentrations of CH<sub>4</sub> and H<sub>2</sub> of 26 μmol L<sup>-1</sup> and 75 μmol L<sup>-1</sup>, respectively. More precise data on the differences of gas concentrations will only be available after having determined the fluid – seawater mixing ratios. The two sampling locations are about 2 km apart and harbour considerably different vent faunas. More information on the factors holding responsible for the different fluid compositions are expected from on shore analyses of stable isotope signatures and trace metal content. However, the data already available illustrate the presence of compositional distinct black smoker vent fluids and faunas within a relatively narrow area at 04°48'S.



Work proceeded by prospecting for hydrothermal activity along the segment A3. Intense survey by CTD and gas measurement failed to recognise any hydrothermal imprint within the water column until station 186 CTD at 09° 27.03'S; 013° 13.99'W revealed considerably enhanced methane concentrations of up to 53 nmol L<sup>-1</sup> (background < 1 nmol L<sup>-1</sup>). Further investigation by numerous CTD casts allowed to presuming active hydrothermalism to occur within a relatively narrow area at about 1500m water depth. An extended area of diffusive fluid outflow accompanied by a dense population of mostly juvenile mussels was spotted and sampled during a ROV dive at this location, the Liliput hydrothermal field. This is by now the southernmost active hydrothermal area discovered along the MAR. The emanating fluid was found to be H<sub>2</sub> prone but relatively rich in CH<sub>4</sub> (Fig. 3) with a H<sub>2</sub>/CH<sub>4</sub> ratio of 0.006. The distribution of dissolved gases within the area indicates that the Liliput field does not considerably contribute to the observed anomalies but additional much stronger sources exist. However, no anomalies could be recognised within the CTD records, neither for light transmission nor for temperature. A second ROV attributed to searching for these sources had to be skipped for severe technical problems.

Table 1.2 CH<sub>4</sub> and H<sub>2</sub> concentrations found in MOR hydrothermal fluids. Note that all data refer to endmembers except those printed in bold (M64/1).

	H <sub>2</sub> [mmol L <sup>-1</sup> ]	CH <sub>4</sub> [mmol L <sup>-1</sup> ]	H <sub>2</sub> /CH <sub>4</sub> molar ratio	ref.
<i>Atlantic</i>				
<i>Peridotitic host rocks</i>				
Rainbow 36°14'N, MAR	13, 16	2,5	5.2-6.4	1, 2
Logachev 15°N, MAR	12	2.1	5.7	2, 13
<i>Basaltic host rocks</i>				
Broken Spur 29°N, MAR	0.43 – 1.03	0.07 – 0.13	6.6 – 7.9	3
Menez Gwen 37°17'N, MAR	0.02 – 0.05	1.35 – 2.63	0.01 – 0.02	6
TAG 26°N, MAR	0.15 – 0.37	0.12 – 0.15	1.2 – 2.47	8, 2
MARK 23°N, MAR	0.19 – 0.48	0.02 – 0.06	7.7 – 8.3	10, 11
Lucky Strike 37°17'N, MAR	0.02 – 0.07	0.0 – 0.97	0.03 – 0.07	8
<b>Turtle Pits 04°49' S, MAR</b>	<b>0.29</b>	<b>0.02</b>	<b>14.7</b>	<b>14</b>
<b>Red Lion 04°47' S, MAR</b>	<b>0.08</b>	<b>0.03</b>	<b>2.87</b>	<b>14</b>
<b>Liliput 09°33' S, MAR</b>	<b>0.00002</b>	<b>0.003</b>	<b>0.006</b>	<b>14</b>
<i>Pacific</i>				
Endeavour. JdF, EPR	0.16 – 0.42	1.8 – 3.4	0.1 – 0.12	12
Southern JdF, EPR	0.27 – 0.53	0.08 – 0.12	3.3 – 4.5	9
21°N EPR	0.23 – 1.7	0.06 – 0.09	3.5 – 20	4
Galapagos	0.001 – 0.004	0.1 – 0.4	0.01 – 0.03	5

1: Donval et al., 1997; 2: Charlou et al., 2002; 3: James et al., 1995; 4: Welhan & Craig, 1979; 5: Lilley et al., 1983; 6: Charlou et al., 2000; 7: Kelley et al., 2001; 8: Charlou et al., 1996; 9: Evans et al., 1988; 10: Campbell et al., 1988; 11: Jean-Baptiste et al., 1991; 12: Butterfield et al., 1994; 13: own data M60/3; **14: This work**

For hydrocarbons of carbon chain lengths from 2 to 4 only saturated homologues were observed (ethane, propane, butanes), but in low concentrations. Molar ratios between methane and higher homologues (C<sub>1</sub>/C<sub>2-4</sub>) were generally above 2000.



### 1.4.6. Detection of hydrothermal plumes with backscatter MAPR system

(S. Fretzdorff, R. Seifert, C. Ostertag-Henning)

#### Introduction

The distribution of hydrothermal plumes within the studied areas has been determined with a Pacific Marine Environmental Laboratory (PMEL) Miniature Autonomous Plume Recorder (MAPR; (Baker and Milburn, 1997)) attached to the cable of a rock-corer, CTD or TV-Grab. The MAPRs include a sensitive light backscatter sensor (LBSS) that provides a relative measure of particle concentration, a 0.001°C resolution thermistor and a strain gauge pressure sensor in a Ti pressure case. Power supply is warranted by four 9 V alkaline batteries. The sampling rate was usually 10sec during deployment, thus the MAPR recorded data approximately every 5 to 10m in the water column. During the first rock-corer stations the MAPR was attached 200m, and later about 80m above the equipment. During CTD stations 2 to 5 MAPRs were mounted 10, 20, 30m etc. above the CTD. In order to compare the signals of the different MAPRs and literature data, the backscattering intensity has been recalculated to nephelometric turbidity unity (NTUs) according to the expression

$$\Delta \text{NTU} = (V_r - V_b)/a_n$$

where  $\Delta \text{NTU}$  is the plume LBSS anomaly in excess of ambient water,  $V_r$  is the raw voltage reading of the LBSS,  $V_b$  is the background voltage not affected by hydrothermal plumes, and  $a_n$  is a factor unique to each LBSS determined from a laboratory calibration using formazine (Baker et al., 2001). All profiles recorded during individual stations of cruise M64/1 are shown in Figure 1.

#### Results

MAPRs were attached during 56 deployments of rock-corer, TV-Grab and CTD stations (Fig. 1.9). In the area of Turtle pits, Wideawake mussel field and Red Lion (4°47S to 4°48S) hydrothermal plume signals have been recorded in nearly all stations (Fig. 1.9a). Unfortunately, during the first TV-Grab and rock-corer stations the MAPR was mounted too high above the equipments to trace the complete plume signal (Fig. 1.9a). During the CTD stations and after mounting the MAPR only 80m above the rock-corer distinct plume peaks centered at approximately 200m above the seafloor could be recorded. The plume signals have a vertical extension in the water column between 150 to 200m (Fig. 1.9a). Only at rock-corer stations 119, 136, and 137 VSR there are no peaks in the recorded nephelometer profiles, probably due to the greater distances (up to 2 km) to the hydrothermal fields. The magnitudes of the anomaly vary from 0.01 up to 0.11  $\Delta \text{NTU}$  volts which is extremely high compared to other light backscattering peaks recorded in hydrothermally active regions like e.g. along the East Pacific Rise (Baker et al., 2001).

4°47S - 4°48S

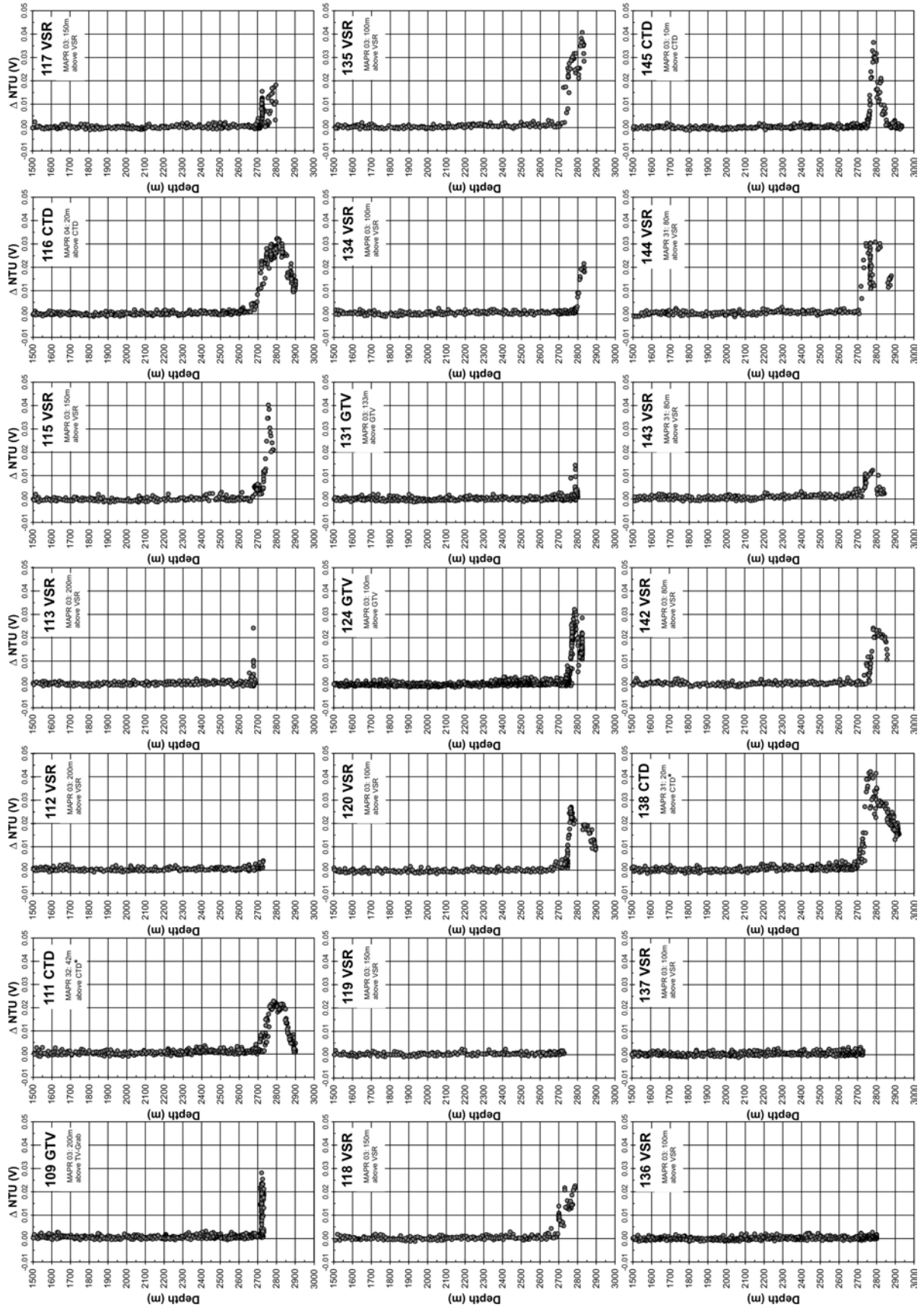


Figure 1.9a: Backscatter profiles ( $\Delta$  NTU) from CTD and rock-corer stations in the area between 4°47 S - 4°48 S. \*one example out of 3 MAPRs.

8°48S - 8°50S

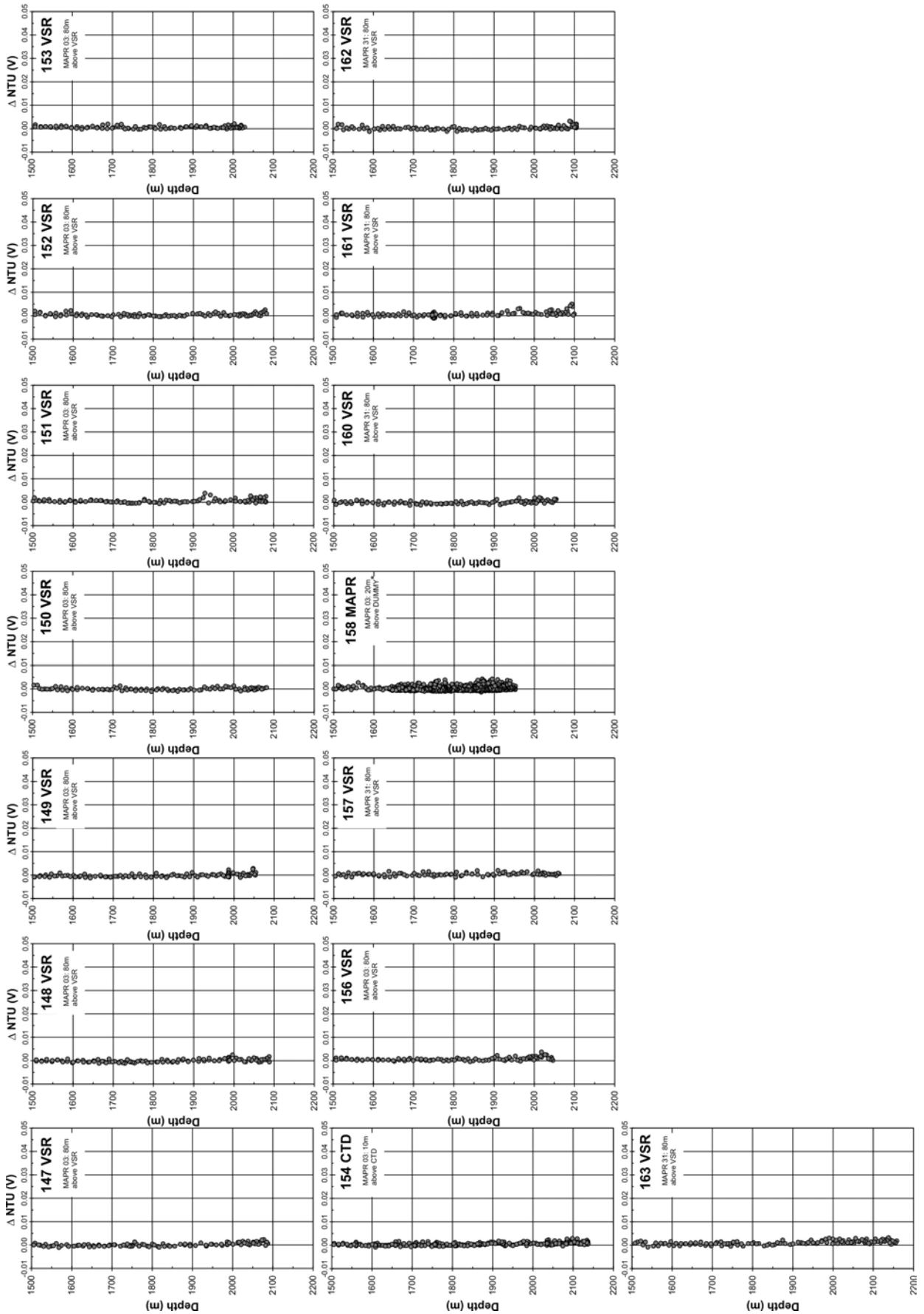


Figure 1.9b: Backscatter profiles ( $\Delta$  NTU) from CTD and rock-corer stations in the area between 8°48 S - 8°50 S. \*one example out of three MAPRs.

9°02S - 9°34S

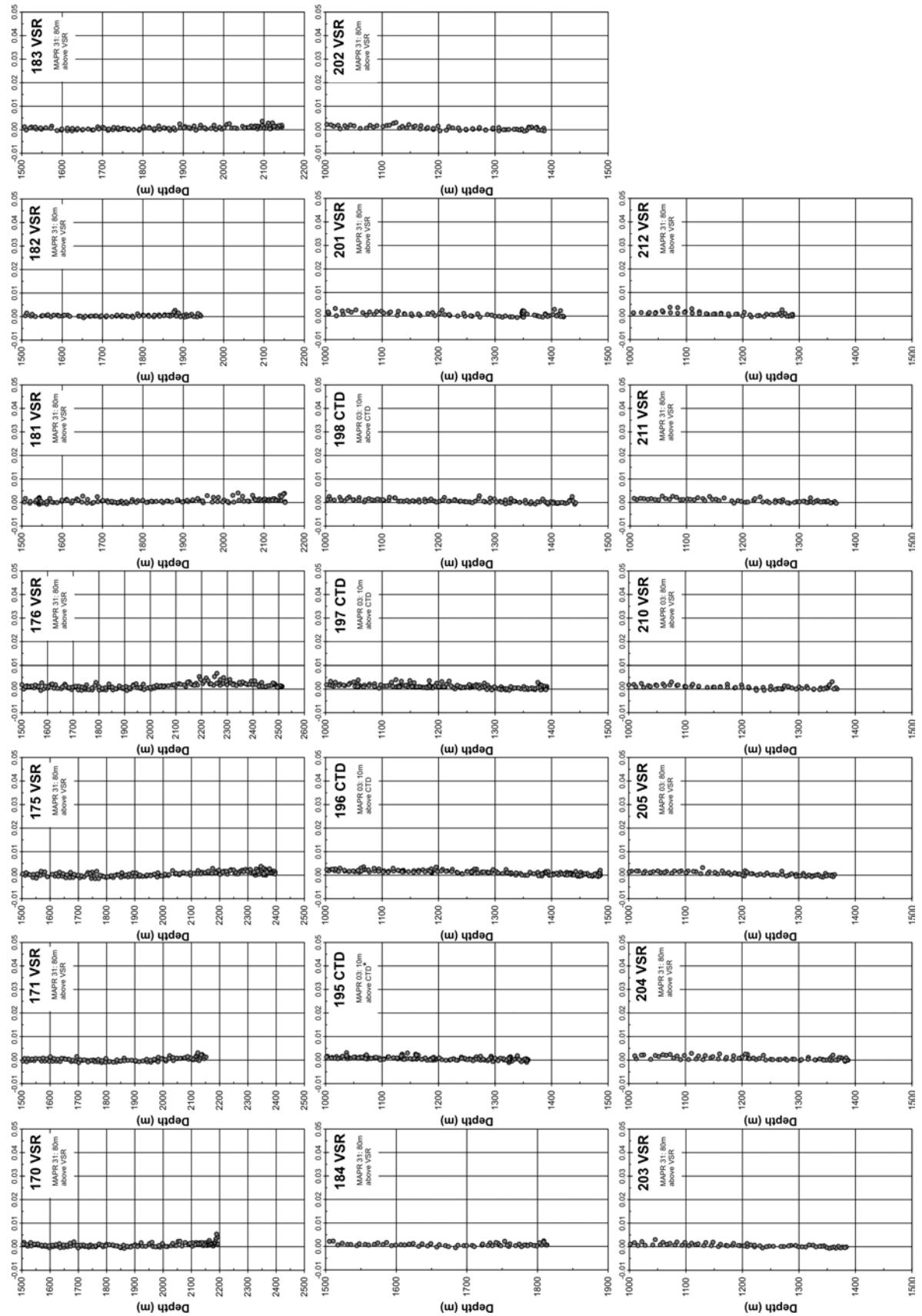


Figure 1.9c: Backscatter profiles ( $\Delta$  NTU) from CTD and rock-corer stations in the area between 9°02 S - 9°34 S. \*one example out of three MAPRs.

In order to map the distribution of the Turtle pits and Wideawake mussel field hydrothermal plumes five MAPRs were mounted 10m, 60m, 110m, 160m, and 210m above a DUMMY (several tyres) and were towed along 5 profiles. Temperature and light backscattering data have been collected during continuous lines of intersecting tow-yos in depth intervals of 2600 to 2900m. An exact x-y-z referencing of the recorded data was possible by using results from the GAPS transponder system. The data have been corrected and a three dimensional grid was constructed by using standard routines for gridding and interpolation in MATLAB onboard. The  $\Delta$ NTU profiles show that the hydrothermal plumes above the Turtle pits and Wideawake mussel fields (located at 4° 48.6' S, 12° 22.36' W) are minor compared to a plume signal/source located west of the studied hydrothermal areas (Fig. 1.10). The output of the Turtle pits and Wideawake mussel field vents seems to be highly variable as evident from the discontinuous  $\Delta$ NTU anomalies above these sites.

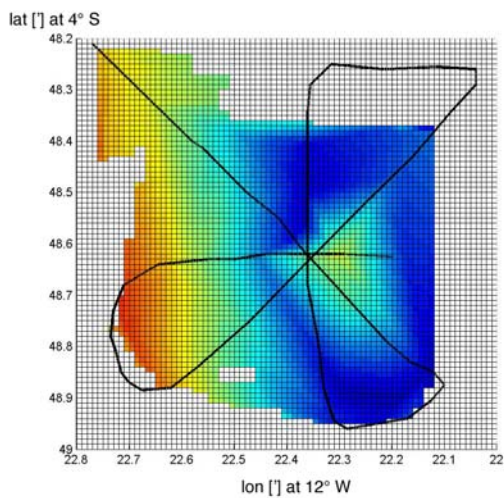


Figure 1.10a: Horizontal slice at 2830 m.

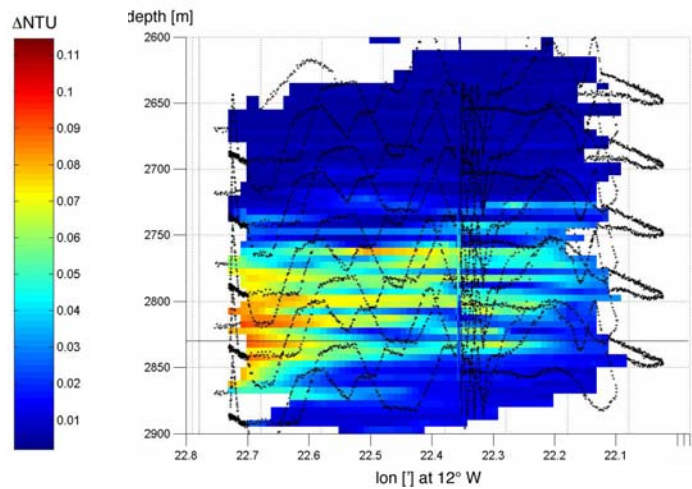


Figure 1.10b: Vertical slice at 4° 48.62' S.

In general, the recorded data in the area of Turtle pits, Wideawake mussel field and Red Lion show no sign of a temperature anomaly in the water column.

Further to the south, between 8°48S to 8°50S and 9°02S to 9°34S the light backscattering profiles show only straight lines, hence no signs of hydrothermal plumes in the water column even above the Lilliput vent field (Fig. 1.9b, c).

### 1.4.7. Zoology and Ecofaunistic Studies

(Jens Stecher, Olav Giere)

#### 1.4.7.1. Goals

- to explore and sample the recently found hydrothermal habitats at 5°S.
- to describe their variability and compare the faunas with that of hydrothermal vents of the northern MAR.
- to select suitable vent locations for faunistic long-term-studies on benthic assemblages, to interpret spatial and time inhomogeneous structures of vent sites.
- to search for new hydrothermal habitats at 9°S

### 1.4.7.2. Methods

Observations were conducted via the ROV Quest (University of Bremen, Marum) and the Ocean Floor Observation System (OFOS, IFM-GEOMAR, Kiel). The ROV observations were made using a LWL-cable with three video cameras and a high-resolution digital still camera. The angle of observation was 84° with a maximum view of 15 m. The OFOS observations were made with a PAL black and white video camera, via coaxial cable. For detailed faunal mapping, a 35 mm analog still camera equipped with an underwater housing and water-corrected lens was used. Pictures were taken for detailed mapping every 30s. These still photographs will be processed after the cruise, and are thus not included in the preliminary results. The fauna was sampled mainly by two kinds of nets with meshes of 100µm and 300µm in diameter. These tools were handled by the manipulator arm of the ROV. In order to get an overview of the dominant taxa the TV-grab was used for sampling. The grab sampled an area of 2m<sup>2</sup>. For meiobenthic analysis sediments were taken and completely preserved with 4% seawater-buffered formalin. Additionally, the shells of mussels and clams which were dissected for genetic analysis were preserved in pure 72% Ethanol. Within the first working area at 5°S samples were successfully taken at 9 of 13 stations. TV-grabs were only undertaken at Turtle Pits and Wideawake Mussel Field. At the Liliput hydrothermal field one dive with the ROV, two TV-grabs and one OFOS station were driven (Table 1.3). The total bottom observation time at Turtle Pits was 31:44 [hh:mm], at Wideawake Mussel Field 10:20 [hh:mm], at Red Lion 18:24 [hh:mm], and at Liliput 15:35 [hh:mm] hours. With a total seafloor observation time of 76:03 [hh:mm] hours combined with successfully sampling at 13 stations, the following description of the faunal assemblages will give a representative first overview.

Table 1.3: List of stations of biological relevant surveys

Station/Tool	field / Location	Date/Bio samples (Yes/No)
108 ROV	Turtle Pits	08.04.2005 / No
114 ROV	Turtle Pits, samples taken at "Tower"	09.04.2005 / Yes
123 ROV	Turtle Pits , samples taken at "Tower"	11.04.2005 / Yes
125 ROV	Wideawake Mussel Field	12.04.2005 / Yes
130 ROV	Turtle Pits, sampled near marker M2	13.04.2005 / Yes
141 ROV	Turtle Pits	15.04.2005 / No
146 ROV	Red Lion. „Shrimps-Smoker“ sampled	16.04.2005 / Yes
200 ROV	Lilliput Hydrothermal field	25.04.2005 / Yes
109 GTV-A	Wideawake Mussel Field	08.04.2005 / Yes
110 GTV-A	Wideawake Mussel Field	09.04.2005 / No
124 GTV-A	Turtle Pits	11.04.2005 / No
131 GTV-A	Turtle Pits, nearby „Stalagmite“	13.04.2005 / Yes
132 GTV-A	Wideawake Mussel Field	13.04.2005 / Yes
139 GTV-A	Turtle Pits, sediments between sulphides	14.04.2005 / Yes
213 GTV-A	Liliput Hydrothermal field	27.04.2005 / Yes
214 GTV-A	Liliput Hydrothermal field	27.04.2005 / Yes
215 OFOS	Liliput Hydrothermal field	27.04.2005 / Yes

### 1.4.7.3. The vent site at 5°S

This site consists of three active hydrothermal habitats. The dominant taxa are decapode crustaceans such as Alvinocarididae, Mirocarididae, and Bythograeidae as well as mussels of the genus *Bathymodiolus*. Within the Wideawake Mussel field the grab samples showed that limpets and annelids are widely distributed, too. Additionally, sea anemones and scyphozoa occur in the different habitats. Besides these general structures each habitat shows own faunistic characteristics.

#### Decapoda

Generally, only *Rimicaris* and *Mirocaris* were found and no *Chorocaris* and *Alvinocaris* were observed. At the smokers of Turtle Pits, both species were sampled at two different smokers with *Rimicaris* being dominant. This stands in contrast to the distribution patterns in the Wideawake Mussel Field. There we sampled more *Mirocaris* than *Rimicaris*, it seemed to be that here *Mirocaris* is more abundant than *Rimicaris*.

At the Red Lion field, consisting of four active black smokers we found only *Rimicaris* in large abundance. At least two smokers, “Shrimps Smoker” and “Sugar Head”, were covered by *Rimicaris* in such dense populations, that the chimneys appeared white. These *Rimicaris* were quite abundant and wide distributed in the vicinity of the field at pillow lava structures, up to 20 m away from the active smokers tending north.

The brachyurian crab likely is *Segonzacia mesatlantica*. It was collected at the chimneys of Turtle Pits and among *Bathymodiolus* specimen at Widewake Mussel Field. They are further abundant at the active chimneys of Red Lion.



**Fig. 1.11:** Decapod crustacean on the “Tower” of Turtle Pits. Specimens of *Rimicaris* c.f. *exoculata*, *Mirocaris*, and *Segonzacia* c.f. *mesatlantica*.



## Bivalvia and Gastropoda

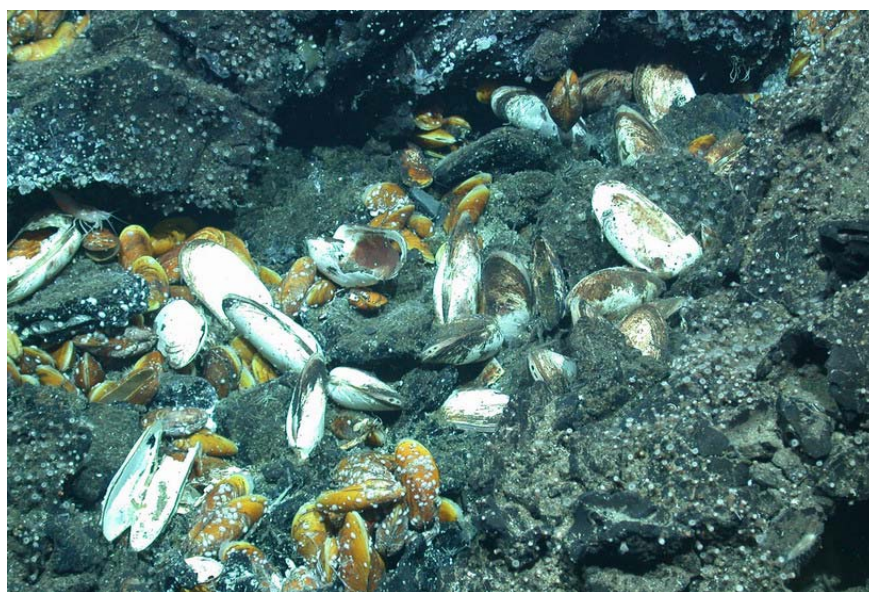
At Turtle Pits no dense patches of living *Bathymodiolus* were found. Only at the margins of the pits as well on the flanks we found some rare specimen. Most of them were dead like at the bottom of active smokers where only shells of dead *Bathymodiolus* could be seen. Neither snails like *Phymorhynchus* nor limpets were present.

In contrast, at the Wideawake Mussel Field living specimens dominated clearly over the dead ones. Within two TV- grabs (each of them covering about 2m<sup>2</sup>) more than 250 living specimen of *Bathymodiolus* were retrieved and no dead shells were among these samples. Additionally only few scavengers like *Phymorhynchus* were documented.

This picture changed in the southern part of the field. Here vesicomid clams were found interspersed in *Bathymodiolus* beds. Although several of the vesicomid clams were still alive, many of them were dead and not longer than 12 cm. Stecher et al. (2002) discussed the change of a natural ageing cycle of diffuse hydrothermal venting, in which clams were replaced by mussels. So a shift of the hydrothermal activity seemed to be visible here in the community structure, which were based on symbiotic microorganisms. Additionally, the scavenger *Phymorhynchus* was more abundant.

Remarkable were the different distribution patterns of limpets: Whereas limpets settled mostly on basalts within the central Wideawake Mussel Field, which is built of single patches of *Bathymodiolus* linked by bands of mussels, they were living on the shells of *Bathymodiolus* in the north-western periphery of the field. The mussels were obviously more patched than within the centre.

With only one exception we did not find any bivalves as well as gastropods at the active smokers of the Red Lion Field. In the northern part of the field we found no more than 60 specimens sitting near the bottom off an inactive smoker. This part of the massive sulphide block was coated by a small white band. If this band consists of bacteria, this might be a sign of slight hydrothermal activity.



**Fig. 1.12:** The *Bathymodiolus* – vesicomid clam association in the southern part of Wideawake Mussel Field.



## Annelids

We identified at least six forms: Terebellida (forms like Ampharetinae), Chaetopterida, some Phyllodocidae (Polynoidae, Spionida), Malanidae, and Archinomidae. These were all sampled in Wideawake Mussel Field mostly within the byssus filaments of *Bathymodiolus*. Only the spionids were attached with their tubes on basalt.

## Cnidaria

Especially in the Wideawake Mussel Field small anemones and scyphozoa settled in dense aggregations on basalt blocks. Larger specimen of sea anemones were regularly observed on the active smokers of Turtle Pits as well as in between the *Bathymodiolus* patches of the Wideawake Field.

### 1.4.7.4. The vent site at 9°33'S – Liliput

The Liliput hydrothermal field is characterised by pillows which are coated with Fe- oxides so that the field appeared in red-orange colours. Shimmering water emerged out of cavities between pillow lavas. Young specimen of *Bathymodiolus* occurred in dense elongated populations along the cavities and along the pillow's cracks. Obviously, postlarval young mussels (0.5mm length) had settled this vent field recently whereas shells of adults were dissolved. Only their periostracum was found with juveniles attached to them by their byssus filaments. The only undissolved shells were found where no active venting was observed. Their length did not exceed 12cm. Shrimps and bythograeid crabs were subdominant, only a few specimen were observed directly at the source of shimmering water. Additionally, scavengers like *Phymorhynchus* were seen in the periphery. Grazers like limpets were not observed. In the vicinity of the mussel beds single gorgonians were sitting on the Fe-oxides coated pillows. These morphotypes of gorgonians are characteristic species of the hydrothermal periphery. These facts indicate that this site is a reactivated diffuse venting site which was recently settled by a new generation of mussels.



Fig. 1.13: The *Bathymodiolus* association at Liliput.

**Conclusions:**

The identified taxa of the hydrothermal fields at 5°S and 9°33'S on the Mid-Atlantic Ridge resemble the northern Logatchev community (Gebruk et al. 2000) in most elements. Remarkable is the missing of following typical hydrothermal taxa within the new discovered fields:

Decapods of the families Alvinocaridae, like *Alvinocaris* and *Chorocaris*, and Galatheidae, echinoderms like Ophiuridae and Ventfishes of the family Zoarcidae.

Obviously, the St. Pauls and Romanche Fracture Zones act only partly as a physical barrier between vent fauna assemblages of the North and South Atlantic Oceans (see Shank 2004).

Therefore, the spatial environmental conditions seemed to be more responsible for faunal differences rather than geographic isolation mechanisms. This stands in line with the results of Desbruyères et al. (2001), comparing different vent fields on the northern Mid-Atlantic Ridge. Therefore they suggested that future investigations should be focused on time series concerning the inter- and intraspecific competitions as well as the variability of microenvironments along gradients.

### 1.4.8. Molecular and structural analysis of symbioses

(Olav Giere)

Our studies followed several investigative lines:

- Molecular comparison of host tissue and symbiotic bacteria from various vents: Do the newly discovered vents south of the MAR fracture zone conform with those from the Logatchev vent field. Are there differences that could relate to a biogeographic separation? Host animals: *Bathymodiolus* cf. *puteoserpentis* (vent mussels) and *Rimicaris exoculata* (vent shrimps).
- Molecular analysis of genetic changes in both host and bacteria from various vent fields: is there a co-evolution between the symbiotic partners or do they evolve independently (cooperation with T. Shank, Woods Hole)?
- Molecular and ultrastructural comparison of the endobacterial consortium harboured in *Bathymodiolus* cf. *puteoserpentis*: does the relation of methanotrophic to thiotrophic bacteria vary at the different vent fields, possibly depending on the varying concentrations of methane and hydrogen sulphide (link to results from projects analysing the fluid chemistry)?
- Analysis of the establishment of the symbiosis: At what stage do the mussel hosts acquire their symbionts from the environment, i.e. contain the newly settled mussels (size 1 – 2 mm) already the complete set of bacteria? Is their distribution in the bacteriocytes identical to that in adult hosts (FISH and ultrastructural studies)?

The material retrieved at both vent fields sampled (4°48 S and 9°33 S) allows for answering all the different approaches outlined above. Results are to be expected after careful analyses in the home labs.

4°48 S: From Wideawake Mussel Field all size ranges of *Bathymodiolus* c.f. *puteoserpentis* could be dissected and the parts fixed; even newly settled specimens in the mm-size class were retrieved. The new hot vent “Shrimp Smoker” yielded numerous *Rimicaris exoculata* of various size classes. The few specimens of *Mirocaris fortunata* sampled allow for the first molecular analysis of possible ectosymbionts on the mouth parts. In addition two specimens of *Calyptogena* sp. were sampled at another, yet unnamed hot smoker, and dissected for molecular analysis. This will enable us to analyse for the first time molecular biologically the symbiosis of an Atlantic species of *Calyptogena*.

9°33 S: Again *Bathymodiolus* c.f. *puteoserpentis* of all size classes

Some limpets populating preferably the mussel shells at Wideawake Mussel Field have been fixed for an exploratory molecular and ultrastructural inspection for symbiotic bacteria (in the gills?).

Compilation of material retrieved:

4°48 S: *Bathymodiolus* c.f. *puteoserpentis*: 30 specimens

*Rimicaris exoculata*: 46

*Mirocaris fortunata*: 8

*Calypptogena* sp.: 2

Limpets: 21

9°33 S: *Bathymodiolus* c.f. *puteoserpentis*: 50 specimens, from newly settled to juvenile; not all sizes allowed for dissection

#### **1.4.9. Microbiology**

##### **1.4.9.1. Samples and methods**

Basalts

(C. Flies)

During the cruise M64/1 different basaltic rocks should be collected

- a) to determine the microbial diversity in cracks and pores of basaltic rocks of different age (started on board continued in the home laboratory). This will be done by several cultivation experiments to isolate aerobic/anaerobic, organo-/lithotrophic and/or heterotrophic/autotrophic microorganisms.
- b) to investigate the microbial diversity of the samples in the home laboratory by molecular analysis like clone libraries of 16S rRNA genes (*Archaea* and *Bacteria*) in combination with amplified ribosomal rDNA restriction analysis – ARDRA and denaturing gradient gel electrophoresis – DGGE.
- c) to study the community structure and morphology of *Bacteria* and *Archaea* in the basaltic rock by electron microscopy and fluorescence in situ hybridization – FISH
- d) to calculate the microbial occurrence and abundance in basaltic rocks based on several geochemical techniques (extraction of organic substances and analysis of specific biomarkers including isotopic analysis) in the home laboratory. Geochemical methods should also be used to analyze pure cultures to correlate the obtained data with single species or specific groups.
- e) to determine sulfate and secondary mineralization products (iron and manganese) by anorganic extraction methods and isotopic analysis in the home laboratory. This products will also be analyzed by FTIR and powder-XRD. Furthermore, the correlation between the biological colonization and the precipitation of secondary minerals should be investigated.

To combine the results for a better understanding of the interactions between basaltic rocks and microbial activity all investigations will be done on identical samples.

Furthermore samples from sediment, deep sea water and surface water should be investigated by microbiological and molecular analysis to get the information about the microbial diversity outside basaltic rocks.

## Hydrothermal systems - fluids, sediments and mineral phases

(J. Süling, M. Perner, J. Küver)

The aim of the cruise was the collection of material in order to perform

- a) Molecular analyses of the microbial community structure of hydrothermal vent systems at 4°48 S and 9°33 S in comparison to the Logatchev vent field (in the home lab)
  - Construction of clone libraries using the 16S rRNA gene (Archaea and Bacteria); Qualitative analyses of present microorganisms.
  - 16S rRNA gene targeted DGGE (Archaea and Bacteria).
  - FISH (Fluorescence in situ Hybridization); Quantification of major phylogenetic groups.
  - Functional gene analyses based on *soxB* (sulfide oxidation), *aprAB* (sulfate reduction, sulfide oxidation), key enzymes of the reductive TCA- cycle, and other CO<sub>2</sub>-fixation pathways.
- b) Cultivation based experiments using specific media (started on board and continued in the home lab)
  - Selective media for autotrophic microorganisms using various electron donors (H<sub>2</sub>, H<sub>2</sub>S, S<sup>0</sup>, S<sub>2</sub>O<sub>3</sub>, Fe<sup>2+</sup>, CH<sub>4</sub>) as well as suitable electron acceptors (O<sub>2</sub>, NO<sub>3</sub>, Fe<sup>3+</sup>, Mn<sup>4+</sup>, S<sup>0</sup>, S<sub>2</sub>O<sub>3</sub>) in the presence of CO<sub>2</sub>.
  - Selective media for aerobic and anaerobic heterotrophic microorganisms.
- c) On board microscopic observations of microorganisms inhabiting freshly taken samples.

### 1.4.9.2. Results

#### Basalts

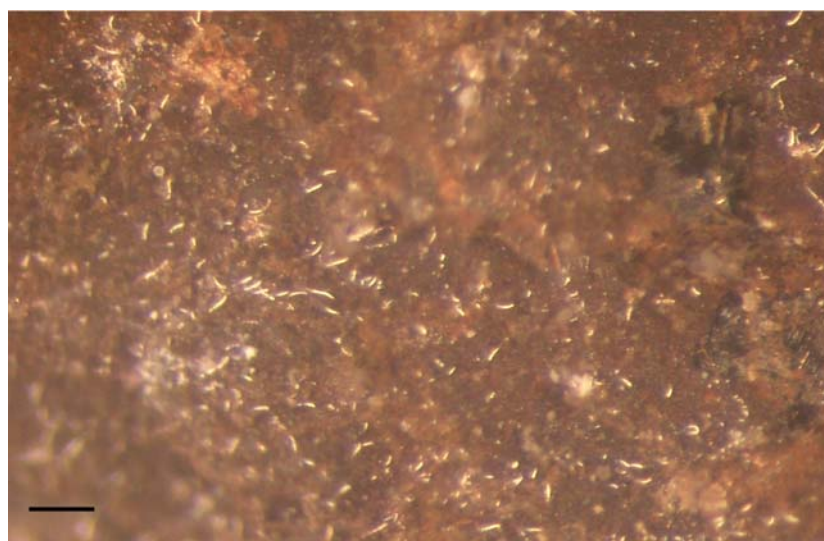
Basaltic rocks from different locations and different ages were taken using the TV grab or ROV (detailed informations will be present in the extended version of the cruise report). The samples were transferred into an anaerobic chamber which was filled with nitrogen. Macroscopic visible organisms like Actiniaria were collected and fixed with ethanol or other fixatives and stored at 4°C or at room temperature. The rock surfaces were sterilized with ethanol and the rock was broken in several pieces using a sterilized hammer and a chisel. Most of the pieces were stored at -20°C, air dried or fixed with glutardialdehyde and formaldehyde for further molecular and geochemical analyses in the home laboratory. Other fragments were separated on board in different subsamples (crust, glass or basalt) and each zone was crushed with a sterile mortar. The splints were used for aerobic and anaerobic cultivation. For aerobic plates the splints were “suspended” in sterile seawater and this solution was used as inoculum. The cultures were incubated at room temperature and transferred to 4°C after several days. In the home laboratory further experiments will be done e. g. agar shakes to obtain pure cultures. Additionally both, splints and the “suspended” basalt were used as inocula for permanent cultures which were stored at -20°C.

### Sediment and water samples:

Sediment samples as well as water samples from the deep sea taken by CTD and surface water were used for permanent cultures and aliquots were frozen for molecular analysis for further investigations in the home laboratory. On board several cultivation experiments were carried out.

### Hydrothermal systems - fluids, sediments and mineral phases

- a) Molecular analyses of the microbial community structure of hydrothermal vent systems will be conducted in the home lab. Samples were taken via the fluid sampling system from diffusive vents as well as from fluids of black smokers during ROV cruises. Other samples represent hydrothermally influenced rocks and sediments which were retrieved via the TV-grab and the wax corer. The samples were frozen at  $-20^{\circ}\text{C}$  and fixed for further treatment. Plume samples were taken using the CTD. These samples were filtered and immediately frozen at  $-20^{\circ}\text{C}$  or fixed for further processing. Detailed information on single samples is shown in the extended version of the cruise report for each working group.
- b) The samples mentioned above were also used for obtaining enrichment cultures. For this purpose selective media as indicated above were used. Growth was monitored by microscopic observation. Autotrophic as well as heterotrophic microorganisms in culture include various morphotypes. Further processing will be conducted in the home lab with the aim to obtain pure cultures.
- c) Microscopic observations of microorganisms inhabiting freshly taken samples revealed heterogenous morphotypes in most samples. Interestingly enough on rock samples collected by the 132 TV-grab at the boarder of a *Bathymodiolus* sp. dominated mussle field two very obvious morphotypes containing sulfur globuli were observed. The white structures (0.5-2mm length) seen in Figure 1.14 consist of several filaments resembling the typical morphological features of *Thiotrix* sp. (non gliding, rosette formation and modified base cells for the attachment to hard substrates). The entire rock sample was irregularly covered by these structures. The filaments enclosed high numbers of sulfur globuli and had a width of up to  $20\mu\text{m}$ .



**Fig. 1.14:** Surface of a rock sample recovered by the 132 TV-grab. The white structures resemble *Thiotrix* sp. Scale bar 2mm. Photo by H. Paulick.

In addition to the sample mentioned above, a sample from 109 TV-grab also collected within the vicinity of a mussel field exhibited a coccoid organism containing numerous sulfur globuli with obvious similarity to *Achromatium* spp. (Fig. 1.15). Besides this large colourless sulfur bacterium which is non motile, several other highly motile small rods and vibrios were observed.

To our knowledge this is the first observation of these two microorganisms at deep sea hydrothermal vent systems. *Thiotrix* spp. have only been found in marine influenced cave systems and like *Achromatium* spp. are known from shallow water hydrothermal vent systems like the golf of Napoli or Paleochori Bay (Milos island).



**Fig. 1.15:** Microscopic picture from an *Achromatium*-like organism (diameter 20 $\mu$ m) with enclosed sulfur globuli. Scale bar 20 $\mu$ m. Photo by H. Paulick.

#### 1.4.10. QUEST Deepwater ROV

(V. Ratmeyer, A. Houk, S. Klar, P. Mason, N. Nowald, W. Schmidt, M. Schroeder, C. Seiter)

The deepwater ROV (remotely operated vehicle) “QUEST 4000m” used during M64-1, is operated by and installed at MARUM, Center for Marine Environmental Sciences at the University of Bremen, Germany. The QUEST is a commercially available, specially adapted for marine science, and 4000 m rated system designed and build by Schilling Robotics, Davis, USA. Aboard RV METEOR for the 5<sup>th</sup> cruise since installation in Mai 2003, the system is well adapted to the research vessel and could be handled during all stages of weather encountered during the cruise.

During M64-1, QUEST performed a total of 13 dives between depths of 1400 and 3100 m. 12 dives with al total of 98 hours bottom time allowed successful scientific sampling and observation at different sites along the Mid Atlantic Ridge.

The total QUEST system weighs 45 tons (including the vehicle, control van, workshop van, electric winch, 5000-m umbilical, and transportation vans) and can be transported in four 20-foot



vans. Using a MacArtney Cormac electric driven storage winch to manage the 5000m of 17.6 mm NSW umbilical, no additional hydraulic connections are necessary to host the system.

The QUEST uses a Doppler velocity log (DVL, 1200kHz) to perform Stationkeep, Displacement, and other auto control functions. Designed and operated as a free-flying vehicle, QUEST system exerts such precise control over the electric propulsion system that the vehicle maintained positioning accuracy within centimeters and decimeters. In addition, absolute GPS positions are obtained using self-calibrating, acoustic IXSEA GAPS USBL positioning system. However, performance of the system was limited to an absolute accuracy below 20 m. For future cruises, absolute position accuracy will hopefully be substantially enhanced after a major upgrade of the GAPS acoustic array.

The combination of 60-kW power with DVL -based auto control functions provides exceptional positioning capabilities at depth. During many dives, QUEST was able to hold position at various depths between 1400 and 3100 m against all currents and cable movements. During dives at the hydrothermal vent fields, the DVL-based, automatically controlled 3D positioning capability allowed highly precise operations for close-up video filming and up to 1 hour continuous fluid sampling on vertical vent structures without vehicle seafloor contact.

The QUEST SeaNet telemetry and power system provides an extremely convenient way to interface all types of scientific equipment, with a current total capacity of 16 video channels and 60 RS-232 data channels. The SeaNet connector design allows easy interface to third-party equipment, particularly to prototype sensor and sampling devices, by combining power-, data-, video-distribution plus compensation fluid transport all through one single cable-connector setup . This ease of connection is especially important in scientific applications, where equipment suites and sensors must be quickly changed between dives. When devices are exchanged, existing cables can be kept in place, and are simply mapped to the new devices, which can consist of video, data, or power transmission equipment.

The substantial empty space inside the QUEST 5 frame allows installation of mission-specific marine science tools and sensors. The initial vehicle setup includes two manipulators (7-function and 5-function), five video cameras, a digital still camera (SCORPIO, 3.3 Megapixel), a light suite (with various high-intensity discharge lights, HMI lights, lasers, and dimmable incandescent lights), a CTD, a tool skid with drawboxes, an acoustic beacon finder and a 675 kHz scanning sonar. Total lighting power is 5 kW, and additional auxiliary power capacity is 8 kW.

During M64-1, additional scientific equipment was installed:

- fluid pump system with remote sampling and temperature probe
- microbiological filtering system
- various “hand” tools including nets, scoops, markers, and an autonomous fluid sampler

For detailed video closeup filming, a near-bottom mounted broadcast quality (870 TVL) 3CCD video camera was used (ATLAS). Continuous video footage was recorded with the ATLAS camera and one additional color zoom video camera (PEGASUS or DSPL Seacam 6500). In order to gain a fast overview of the dive without the need of watching hours of video, one video feed is continuously frame-grabbed and digitized at 5sec intervals.

The QUEST control system provides transparent access to all RS-232 data and video channels. The scientific data system used at MARUM feeds all ROV- and ship-based science and logging channels into a commercial, adapted real-time database system (DAVIS-ROV). During operation, data and video are distributed in realtime to minimize crowding in the control van. Using the existing ship's communications network, sensor data is distributed by the real-time database via TCP/IP from the control van into various client laboratories, regardless of the original raw-data format and hardware interface. This allows topside processing equipment to perform data interpretation and sensor control from any location on the host ship.

Additionally, the pilot's eight-channel video display is distributed to client stations in labs and bridge on the ship via CAT5 cable. This allows the simple setup of detailed, direct communication between the bridge and the ROV control van. Similarly, information from the pilot's display is distributed to a large number of scientists. During scientific dives where observed phenomena are often unpredictable, having scientists witness a "virtual dive" from a laboratory rather than from a crowded control van allows an efficient combination of scientific observation and vehicle control.

Post-cruise data archival will be hosted by the information system PANGAEA at the World Data Center for Marine Environmental Sciences (WDC-MARE), which is operated on a long-term base by MARUM and the Foundation Alfred Wegener Institute for Polar and Marine Research, Bremerhaven (AWI).

## **1.5. Weather Conditions during M64/1**

(W. Ochsenhirt)

On April 02 forenoon MV METEOR left the port of Mindelo (Cape Verde Islands) heading south. The winds encountered were constant northeasterly tradewinds of Bft 4 or 5. On April 06 the research vessel came to the intertropical convergence zone (ITCZ) near 8°N. When Passing the ITCZ the winds were calm and variable and during the following night an intensive tropical shower occurred. On the next day near 02.30 North the ITCZ was already far north of the ships position. The Equator was crossed in the afternoon of April 06 and the tradewinds came from southeast with Bft 4 or 5.

In the evening of April 07 the first investigations started near 4.48°S, 12.24°W and were continued until 09.43°S, 13.06°W. During this time METEOR was situated at the edge of the subtropical high in the central South Atlantic. The southeasterly tradewind was mostly steady with 4 or 5, Bft, only for short periods Bft 6. Swell from south or southeast often occurred with a height of 2, sometimes up to 3 m.

In the afternoon of April 27 the investigations ended and METEOR headed for Fortaleza in a direct course. Under the influence of southeasterly to easterly following tradewinds of 3 to 5 Bft the transit voyage was no problem. METEOR arrived in Fortaleza in the early morning of May 03.

**1.6. Station List M64/1**

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
109GTV-1	08.04.2005	04°48.64	12°22.36	2998	Fresh, glassy basalt; aphyric sheet flow.
109GTV-2	08.04.2005	04°48.64	12°22.36	2998	Very fresh aphyric sheet flow, wrinkled surface.
109GTV-3	08.04.2005	04°48.64	12°22.36	2998	basalt with 1 cm glass crust.
109GTV-4	08.04.2005	04°48.64	12°22.36	2998	Piece of fresh, glassy sheet flow lava, wrinkled surface, aphyric.
109GTV-5	08.04.2005	04°48.64	12°22.36	2998	Fresh, aphyric sheet lava with 1 cm glass rind on both sides.
110GTV-1	09.04.2005	04°48.55	12°22.36	2998	Fresh, aphyric sheet flow, 1 cm glassy rim.
110GTV-2	09.04.2005	04°48.55	12°22.36	2998	Aphyric basalt glass.
110GTV-3	09.04.2005	04°48.55	12°22.36	2998	Fresh aphyric basalt, glassy margins on both sides of sample.
111CTD	09.04.2005	04°48.6	12°22.4	2998	
112VSR-1	09.04.2005	04°48.75	12°22.28	2995	Small glass particles.
113VSR-1	09.04.2005	04°48.77	12°21.76	2951	Fresh, aphyric basalt glass.
113VSR-2	09.04.2005	04°48.77	12°21.76	2951	Fresh glassy ash with foram. sand.
114ROV-4A*	10.04.2005	04°48.579	12°22.418	2993	Piece of black smoker chimney, zoned, interior consists of chalcopyrite (friable, porous). Outer rim: 1-2 cm of pyrite-marcasite, marcasite-rich outer crust coated with Fe-Oxihydroxides.
114ROV-5A*	10.04.2005	04°48.579	12°22.418	2993	Zoned black smoker chimney. Outer 2 - 5 cm: pyrite-marcasite crust, interior; chalcopyrite-rich with abundant anhydrite and rare sphalerite. Prominent ribbon banding. Central conduit is open: 4 to 9 cm in diameter lined and filled by anhydrite (partially intergrown with fine-grained sulfide [sphalerite?]).
114ROV-5B-F*	10.04.2005	04°48.579	12°22.418	2993	Several small pieces of pyrite-marcasite black smoker crustal material, behve-like layering.
114ROV-5G-H*	10.04.2005	04°48.579	12°22.418	2993	Porous, friable chalcopyrite-rich material from black smoker interior.
114ROV-5Bag*	10.04.2005	04°48.579	12°22.418	2993	Loose sulfide rubble, very porous, soft, collected in bionet.
114ROV-6*	10.04.2005	04°48.579	12°22.418	2984	Sample of beehive structure, similar to sample 114-4; outer marcasite crust, interior is porous chalcopyrite showing behve layering.
114ROV-7*	10.04.2005	04°48.579	12°22.418	2984	Piece adjacent to 114-6 but not behve structured (more like a layered knob); marcasite-rich outer crust; chalcopyrite-rich interior.
115VSR-1	10.04.2005	04°48.77	12°22.61	3048	Basalt glass with large plagioclase phenocryst (10 mm in diameter).
115VSR-2	10.04.2005	04°48.77	12°22.61	3048	Glass particles with plagioclase phenocrysts.
116CTD	10.04.2005	04°48.8	12°22.7	2961	
117VSR-1	10.04.2005	04°48.25	12°23	3033	Two small pieces of aphyric basalt glass.
118VSR-1	10.04.2005	04°48.26	12°22.23	3000	Very fresh aphyric glass.
119VSR-1	10.04.2005	04°48.26	12°21.48	2980	Fresh basaltic glass with plagioclase phenocrysts (max. 1 cm).
120VSR-1	10.04.2005	04°47.79	12°22.97	3050	~1 cm thick glass crust, basalt with several plagioclase phenocrysts up to 1 cm.
121CTD	11.04.2005	04°47.8	12°22.6	3022	
122CTD	11.04.2005	04°48.5	12°22.4	2971	

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Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
123ROV-4A*	11.04.2005	04°48.583	12°22.41	2986	Outer portion of active chimney consisting of numerous, friable microchimney structures (1 - 5 cm diameter). Marcasite crust. Interior is complex and zoned grading from anhydrite, sphalerite to pyrite-sphalerite to chalcopyrite. Exterior is partially oxidized and locally covered with white bacterial? dots.
123ROV-4B*	11.04.2005	04°48.583	12°22.41	2986	Two fragments of chimney interior, chalcopyrite-anhydrite association.
123ROV-4C*	11.04.2005	04°48.583	12°22.41	2986	Various fragments of chimney exterior, marcasite-pyrite + Fe-oxihydroxide + white coatings. Finer rubble with chalcopyrite-rich material, anhydrite, microchimneys.
123ROV-8	11.04.2005	04°48.58	12°22.4	2985	Aphyric basalt, lobate feature on surface of jumbled sheet flow. 3 mm thick glass on both sides. Interior is microcrystalline with large lensoidal cavities parallel to outer surfaces (drain-out feature?) lines with thin Mn-Oxide film.
123ROV-9*	11.04.2005	04°48.559	12°22.413	2990	Piece of inactive sulfide chimney, recrystallized. Chalcopyrite-rich interior ca. 5 cm in diameter, partly oxidized (pigeon coloration). Outer zone is sphalerite-pyrite-marcasite. Crust is marcasite, outer crust is 1 mm thick Fe-oxihydroxide.
124GTV-1A*	11.04.2005	04°48.573	12°22.424	2998	Three pieces of approx. similar size, slabby blocks of aphyric basalt, 1-2 mm of glass crust on both sides and extensive Fe-oxihydroxide coating.
124GTV-1B*	11.04.2005	04°48.573	12°22.424	2998	Similar to 124-1A but with prominent wrinkles on the surfaces.
124GTV-2A*	11.04.2005	04°48.573	12°22.424	2998	Massive pyrite/marcasite; outer 5 mm biogenic(?) marcasite crust followed by 1 cm massive marcasite, interior pyrite: dendritic growth cross cutting beehive layering.
124GTV-2B*	11.04.2005	04°48.573	12°22.424	2998	Same as 2A + small normal fractures lined with chalcopyrite. Zones of sphalerite enrichment.
124GTV-2C*	11.04.2005	04°48.573	12°22.424	2998	Same as 2A but interior is with more chalcopyrite (Cu-rich end member of this type).
124GTV-2 D to M*	11.04.2005	04°48.573	12°22.424	2998	Crustal material of black smoker chimney: pyrite + marcasite, rare to trace sphalerite + chalcopyrite in cavities and along fractures.
124GTV-2G*	11.04.2005	04°48.573	12°22.424	2998	Similar to 2A but more black sphalerite, Zn-rich end member of this type.
124GTV-3 A to -C*	11.04.2005	04°48.573	12°22.424	2998	Massive pyrite-marcasite with strong beehive texture.
125ROV-1A	12.04.2005	04°48.6111	12°22.327	3000	Glassy aphyric lava with large vesicle (max. diameter is 5 cm) and some spotty biological coating.
125ROV-4	12.04.2005	04°48.6111	12°22.327	3000	Aphyric basalt crust, 4 cm thick, 3 mm glass crust with rough polyhedral joints. Interior is microcrystalline with small vesicles and 3-4 cm thick lower surfaces showing complex plastic deformation and lava stalagmites.
125ROV-6	12.04.2005	04°48.624	12°22.355	2986	Three pieces, basalt overgrown with scyphocytes, aphyric basalt, 2 mm thick glass crust, interior with large vesicles.

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Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
125ROV-8	12.04.2005	04°48.635	12°22.345	2985	Aphyric basalt, 3 mm thick glass crust, interior is microcrystalline. Fracture surfaces normal to top of sample are coated with Fe-oxihydroxides.
125ROV-9	12.04.2005	04°48.634	12°22.355	2986	Very fresh glass from flow carapace, abundant quench fractures, <1 vol% olivine phenocrysts, max. diameter ~1mm, locally with elongate to lensoidal vesicles up to 2 x 3 cm, no small vesicles.
125ROV-10	12.04.2005	04°48.634	12°22.355	2986	Some more fragments of the same type and the same location as sample 125-9 (see above).
126CTD	12.04.2005	04°46.8	12°23.2	3063	
127CTD	13.04.2005	04°48.7	12°23.0	2959	
128CTD	13.04.2005	04°48.8	12°22.4	2967	
129CTD	13.04.2005	04°48.6	12°22.6	2982	
130ROV-1*	13.04.2005	04°48.57	12°22.417	2985	There are two types of fragments: 1. Chimney interior consisting of anhydrite and chalcopyrite. 2. Chimney crust consisting of pyrite, chalcopyrite and marcasite, partially covered by Fe-oxihydroxides.
130ROV-2*	13.04.2005	04°48.57	12°22.417	2985	Hollow chimney structure with 2 cm thick walls. Walls consist of cpy and marcasite and a 1-5 mm marcasite crust. Interior of the vent (5 x 3 x 2 cm) is extensively lined by 1-3 mm thick pyrrhotine crust with beautiful blade crystals up to 1 mm in diameter.
130ROV-3*	13.04.2005	04°48.57	12°22.417	2985	Particles are 5 to <1mm, 75% pyrite particles including some collomorphic aggregates; 10% basalt glass chips (max. 5 mm); 10% anhydrite <1 mm, some larger particles are well-rounded due to resorption by seawater; <5% cpy (altered) and pyrite aggregates, <1% globigerina; rare goethite.
131GTV-1	13.04.2005	04°48.57	12°22.37	2999	Piece of aphyric basalt with 1 x 1 cm mafic xenolith. Wrinkled to bulbous crust of a sheet flow with 1 to 5 mm glassy upper surface (locally some Feox-hydrox. staining). Lower surface shows plastic deformation indicating that this is the roof of a lava lobe/tunnel. Xenoliths of gabbro (cpx to 8 mm and plag to 2 mm) up to 5 cm in diameter.
131GTV-2	13.04.2005	04°48.57	12°22.37	2999	Similar to 131-1. Crust of drained lava tube. Top surface shows ropy texture; 2 to 3 mm thick glass covered by Fe-Oxihydroxides. Margins of piece are normal fractures covered by Fe-Oxihydroxides and biology.
131GTV-3	13.04.2005	04°48.57	12°22.37	2999	Similar to 131-1 and 2. Platy slab representing the roof of a drained sheet lava flow. Top is flat and covered by <1 mm hydrothermal(?) crust. Glass is 10 mm thick and shows nice gradation over 3 mm into microcrystalline interior. Lower surface shows lava stalagmites.
131GTV-4	13.04.2005	04°48.57	12°22.37	2999	Similar to 131-1,-2, and -3. Lava tongue (4 cm thick) with 1 to 5 mm thick glass on both sides. Top surface is ropy to wrinkled.
131GTV-5	13.04.2005	04°48.57	12°22.37	2999	Aphyric lava with gabbroic xenoliths: clinopyroxene and plagioclase up to 8 mm.
132GTV-1	14.04.2005	04°48.62	12°22.34	2996	Fresh lava piece, bulbous, aphyric, 10 mm of glass on both sides.

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Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
132GTV-2	14.04.2005	04°48.62	12°22.34	2996	Similar to 132-1, fresh surface with biological colonization.
132GTV-3	14.04.2005	04°48.62	12°22.34	2996	Similar to 132-1.
133CTD	14.04.2005	04°48.6	12°22.4	2966	
134VSR-1	14.04.2005	04°49.01	12°23.05	3000	Basaltic glass with plagioclase phenocrysts.
135VSR-1	14.04.2005	04°49.02	12°22.51	3001	Two pieces of aphyric basalt lava with 1 cm glass crust.
136VSR-1	14.04.2005	04°48.26	12°21.86	2970	Aphyric basalt glass + some globigerina.
137VSR-1	14.04.2005	04°48.23	12°21	2903	Foraminiferous sediment.
138CTD	14.04.2005	04°47.8	12°22.6	2971	
139GTV-1 to 8	14.04.2005	04°48.57	12°22.417	2985	Diverse association of different types of sulfides: individual cpy-rich chimneys, pyrite-marcasite-chimneys, coalesced microchimneys, anhydrite-rich pieces with varying proportions of magnetite+chalcopyrite, cavities lined with euhedral gypsum crystals, friable magnetite-rich samples, minor sphalerite; locally oxidation => hematite bands.
140DUMMY	14.04.2005	04°48.2	12°22.9	3035	
141ROV_AC-6	15.04.2005	04°48.56	12°22.41	2985	Pyrite-marcasite crust, chalcopyrite in the interior is typically altered (pigeon color). Redbrown outer surface: Fe-oxihydroxide coating. One piece with central vug (2 x 3 cm) line with pyrrhotite + isocubanite (?). Some of the fragments contain 1-3 mm layer of magnetite separating the chalcopyrite and pyrite-marcasite zones.
142VSR-1	15.04.2005	04°48.75	12°22.52	3004	Several aphyric basalt glass fragments.
143VSR	16.04.2005	04°48.9	12°22.0	2983	empty
144VSR	16.04.2005	04°48.0	12°22.6	3023	empty
145CTD	16.04.2005	04°48.9	12°22.8	2974	
146ROV-1	16.04.2005	04°48.88	12°22.93	2973	Altered, highly plagioclase-phyric basalt, 20 % plagioclase phenocrysts up to 12 mm in diameter. Sample of lava crust. Glass is completely altered (clay-Mn Oxide, Fe Oxihydroxide), abundant biological colonization.
146ROV-2	16.04.2005	04°48.35	12°22.69	3024	Fresh glassy aphyric basalt; large elongate cavities: long axis (>5 cm) parallel to the flow fold axis.
146ROV-3	16.04.2005	04°47.902	12°22.618	3045	Sulfide knob on inactive chimney. Friable interior with irregular cavities lined by sphalerite and chalcopyrite (crystals <1 mm). Bulk of the piece consists of chalcopyrite-marcasite. Crust: 2 mm black Fe-oxihydroxide.
146ROV-7	16.04.2005	04°47.824	12°22.595	3048	Sphalerite-rich fragment of active smoker. Internal cavity (2 x 1.5 cm) lined by pyrrhotite (+isocubanite?). Crust of Fe-oxihydroxide is extensively coated by white material (sulfur?) and orange-brown globules coated by Fe-oxides .
147VSR	18.04.2005	08°50.0	13°29.7	2224	empty
148VSR-1	18.04.2005	08°49	13°29.8	2230	Small chips of gray, microcrystalline aphyric basalt, trace of glass chips.
149VSR	18.04.2005	08°48.0	13°31.0	2214	empty

Cruise Report Meteor M64/1 – MARSUED I (April 02 – May 03 , 2005)

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
150VSR-1	18.04.2005	08°48.01	13°30.3	2211	Small amount of glass particles.
151VSR-1	19.04.2005	08°47.99	13°30.1	2219	Basalt
152VSR-1	19.04.2005	08°47.99	13°29.81	2223	Several glass pieces.
153VSR-1	19.04.2005	08°47.99	13°29.29	2165	Shell fragments (sediment patch).
155ROV-1	19.04.2005	08°48.98	13°30.5	2161	Glassy basalt from talus breccia, covered by mud, rare <1mm olivine phenocrysts.
155ROV-2	19.04.2005	08°48.99	13°30.44	2172	Microcrystalline basalt, ca. 5% vesicles up to 2 mm in diameter, <1% olivine phenocrysts up to 1 mm, top coated by Mn-Oxide crust, abundant microorganisms.
155ROV-3	19.04.2005	08°49	13°30.3	2149	Four cm thick roof of lava lobe. Top surface is glassy (2 mm thick), 5 % vesicles up to 5 mm in the microcrystalline basalt below the glass crust; lower surface with stalagmite texture; rare olivine phenocrysts <1mm.
155ROV-4	19.04.2005	08°48.96	13°30.17	2195	Aphyric basalt, pillow section, microcrystalline with partially palagonitized glass crust (ca. 1 mm); 2 % vesicles up to 2 mm.
155ROV-5	19.04.2005	08°48.99	13°30.06	2199	Altered aphyric basalt with <1% pyroxene and rare plagioclase (<1 mm). Piece consists of two individual lobes showing ductile deformation.
155ROV-6	19.04.2005	08°48.99	13°30.04	2190	Piece of pillow crust with prominent striated top surface texture. Roof (3 cm thick) of partially drained pillow. Glass on both sides (top: 2 to 4 mm; base < 1mm). Partial palagonitization. 1% olivine phenocrysts up to 5 mm.
155ROV-7	19.04.2005	08°48.99	13°29.97	2221	Abundant aphyric basalt glass chips of pillow crust. Partially palagonitized.
155ROV-8	19.04.2005	08°49.04	13°29.85	2218	Single piece of microcrystalline basalt with 1% olivine phenocrysts (up to 1 mm); ca 1% vesicles (up to 2 mm). Glass crust is 1-3 mm thick and locally shows spherulitic textures.
156VSR-1	19.04.2005	08°48.43	13°30.42	2208	Basalt glass.
157VSR-1	19.04.2005	08°47.7	13°30.56	2190	Basalt glass.
158DUMMY	20.04.2005	08°53.1	13°31.2	2198	
159ROV-1	20.04.2005	08°48.18	13°30.12	2204	Glassy basalt with 1% olivine and plagioclase phenocrysts up to 1 mm, some palagonite.
159ROV-2	20.04.2005	08°48.15	13°30.12	2201	Basalt with 3 mm glass crust, <1% plagioclase phenocrysts 2% vesicles up to 2 mm, minor Fe staining.
159ROV-3	20.04.2005	08°48.06	13°30.12	2198	Aphyric glassy basalt; flow fold quenched on both sides, slight palagonitization, microcrystalline groundmass surrounds elongate cavity (long axis >4 cm parallel to fold axis).
159ROV-4	20.04.2005	08°47.99	13°30.12	2201	Aphyric glassy basalt, abundant shards <1 to 3 cm in diam./pteropod sand.
159ROV-5	20.04.2005	08°47.96	13°30.16	2186	Piece of lava protrusion, plagioclase-phyric glassy basalt, 10 vol.% plagioclase phenocrysts up to 10 mm, surface with striation marks, glass crust partially palagonitized and covered by thin layer of black Mn-oxide.



Cruise Report Meteor M64/1 – MARSUED I (April 02 – May 03 , 2005)

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
159ROV-6	20.04.2005	08°47.81	13°30.19	2151	Abundant fragments of aphyric basalt glass shards.
159ROV-7	20.04.2005	08°47.75	13°30.21	2201	Plagioclase-phyric basalt with 2 mm glass crust, <1% plagioclase up to 1 mm, 3% vesicles up to 2 mm, several zones of shearing up to 1 cm wide oriented parallel to the surface spaced at 2-4 cm intervals. Slight Fe-Oxihydroxide staining.
159ROV-8	20.04.2005	08°47.76	13°30.21	2202	Basalt with 1-2 mm glass crust, slightly palagonitized, few plagioclase phenocrysts (< 1mm), 1 vol. % vesicles up to 1 mm.
159ROV-9	20.04.2005	08°47.5	13°30.21	2215	Pillow top is glassy (1-2 mm thick), slight palagonitization, <1% plagioclase and olivine, up to 1 mm, lower surface is undulated, solidified lava droplets.
159ROV-10	20.04.2005	08°47.46	13°30.18	2219	Small lava fold with glassy crust (1-2 mm), plagioclase-phyric basalt, 1% plagioclase up to 1 mm.
159ROV-11	20.04.2005	08°47.46	13°30.18	2219	Lava lobe of 4 cm thickness with glassy crust on both sides, abundant palagonitization, 1% plagioclase phenocrysts up to 5 mm, rare olivine.
160VSR-1	20.04.2005	08°46.93	13°30.39	2208	Basalt glass.
161VSR-1	20.04.2005	08°46.7	13°30.57	2266	Basalt glass with plagioclase phenocrysts.
162VSR-1	21.04.2005	08°46.22	13°30.64	2273	Basalt glass with plagioclase phenocrysts.
163VSR-1	21.04.2005	08°45.43	13°30.74	2287	Basalt glass with plagioclase phenocrysts.
164CTD	21.04.2005	08°54.0	13°29.2	2122	
165VSR-1	21.04.2005	08°50	13°29.68	2225	Aphyric basalt glass.
166VSR-1	21.04.2005	08°50.51	13°29.48	2188	Chips and fragments of microcrystalline and glassy basalt.
167CTD	21.04.2005	09°00	13°29	1974	
168CTD	21.04.2005	09°00	13°28	2153	
169CTD	21.04.2005	09°00	13°27	2244	
170VSR-1	21.04.2005	09°20	13°27	2313	Sediment in vaseline with a few glass particles.
171VSR-1	21.04.2005	09°4.01	13°26.6	2320	Sediment patches.
172CTD	22.04.2005	09°7.5	13°27.0	2530	
173CTD	22.04.2005	09°7.5	13°26.0	2530	
174CTD	22.04.2005	09°7.5	13°25.0	2530	
175VSR-1	22.04.2005	09°7.5	13°25.86	2530	Olivine-phyric basalt (1% olivine phenocrysts up to 2 mm), glassy and microcrystalline fragments, moderate palagonitization.
176VSR-1	22.04.2005	09°9.02	13°25.51	2640	Basalt glass.
177CTD	22.04.2005	09°10.5	13°26.1	2654	
178CTD	22.04.2005	09°10.4	13°25.0	2582	
179CTD	22.04.2005	09°10.5	13°24.0	2284	
180CTD	22.04.2005	09°10.5	13°23.0	2372	
181VSR-1	22.04.2005	09°15.29	13°17.5	2285	Altered glass crust with sediment.
182VSR-1	22.04.2005	09°17.02	13°17.02	2072	Very few glass chips.
183VSR-1	22.04.2005	09°20.9	13°17.1	2261	empty
184VSR-1	23.04.2005	09°22.49	13°15.53	1932	Few thin rock fragments.
185CTD	23.04.2005	09°19.0	13°17.0	2370	

Cruise Report Meteor M64/1 – MARSUED I (April 02 – May 03 , 2005)

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
186CTD	23.04.2005	09°19.0	13°16.0	1932	
187CTD	23.04.2005	09°19.0	13°15.0	2059	
188ROPV_P-1	23.04.2005	09°42.48	13°5.02	1772	Piece of aphyric basalt lava. Roof of lava lobe. Glassy crust with abundant palagonitization. Rare olivine phenocrysts (< 1 mm), ca 1% vesicles up to 5 mm. Extensive Mn-oxide coating.
188ROPV_P-3	23.04.2005	09°42.49	13°4.96	1787	Piece of aphyric lava lobe. 1 to 2 mm glassy crust with intense palagonitization. Ca. 5 % tubular vesicles (1 mm x 10 mm) concentrated below crust. Extensive Mn-oxide coating and biological colonization.
188ROPV_P-4	23.04.2005	09°42.49	13°4.8	1857	Piece of aphyric basalt lava lobe with rare olivine phenocrysts. Glass crust (1 to 3 mm) is heavily palagonitized. Some Fe-oxihydroxide alteration and abundant worm tubes. Vesicles: <1%, < 1mm.
188ROPV_P-5	23.04.2005	09°42.39	13°4.67	1864	Two pieces of small lava lobe. Glass crust (1 to 2 mm) is strongly palagonitized. Vesicles: < 1%, < 1 mm.
188ROPV_P-7	23.04.2005	09°42.36	13°4.51	1882	Aphyric basalt pillow. Glass crust (1 to 2 mm) is strongly palagonitized. Coated by Mn-oxide and some biological colonization.
189CTD	23.04.2005	09°27.0	13°14.0	1701	
190CTD	23.04.2005	09°27.0	13°16.0	2083	
191CTD	23.04.2005	09°27.0	13°12.0	1886	
192CTD	24.04.2005	09°30.0	13°13.0	1653	
193CTD	24.04.2005	09°32.5	13°12.9	1458	
194ROPV_P-1	24.04.2005	09°34.37	13°12.95	1454	One piece of aphyric pillow basalt. Vesicles: 3% up to 3 mm. Palagonitized glass crust (1-3 mm); Mn-oxide and Fe-oxihydroxide coating and some biology.
194ROPV_P-4	24.04.2005	09°34.37	13°12.86	1429	Section of aphyric pillow basalt. Vesicles: 5% up to 10 mm. Palagonitized glass crust. Extensive Mn-oxide coating. Biological colonization including trunk of gorgonaria.
194ROPV_P-6	24.04.2005	09°34.37	13°12.77	1436	Aphyric basalt. Extensive palagonitization and Mn-oxide coating.
194ROPV_P-7	24.04.2005	09°34.37	13°12.67	1448	Roof of lava lobe; Top: wrinkled glass (ca. 5 cm), fresh. Aphyric. Vesicles: 3%, up to 1 mm.
194ROPV_P-8	24.04.2005	09°34.41	13°14.53	1465	Section of pillow. Rare olivine phenocrysts (up to 1 mm). Vesicular central part (30% up to 20 mm, locally coalesced). Tubular vesicles (up to 4 cm long) oriented normal to the exterior in the outer 10 cm of the section. Outermost 1-2 cm are vesicle-free. Some glassy patches preserved.
194ROPV_P-9	24.04.2005	09°34.43	13°12.52	1465	Three pieces of aphyric basalt with 1 to 3 mm glass crust.
194ROPV_P-10	24.04.2005	09°34.37	13°12.5	1470	Vesicular aphyric basalt. Vesicles: 10%, up to 5 mm, locally coalesced. Outer zone (1 cm) is vesicle-free. Glass crust (1-2 mm) is slightly palagonitized.

Cruise Report Meteor M64/1 – MARSUED I (April 02 – May 03 , 2005)

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
194ROPV_P-11	24.04.2005	09°34.38	13°12.49	1470	Piece of aphyric lava fold with 1 mm glass crust on both sides. Central zone contains 20% vesicles up to 1 cm; abundant tubular vesicles oriented normal to the exterior. Outer 1 cm on both sides are vesicles-free.
194ROPV_P-12	24.04.2005	09°34.38	13°12.34	1460	Crust of aphyric lava lobe with wrinkly lower surface. Slightly palagonitized glass crust (1 to 2 mm). Vesicles are tubular, oriented normal to the surface (20%).
194ROPV_P-13	24.04.2005	09°34.38	13°12.34	1468	Slab of aphyric sheet flow exposed in collapse pit. Roof of lava tunnel. Top surface is wrinkled on 10 cm scale. Fresh glassy crust with prominent perlitic texture. Lower surface with abundant lava droplets, thin-walled bubbles and linear lava stalagmites.
195CTD	24.04.2005	09°34.5	13°12.5	1402	
196CTD	24.04.2005	09°31.5	13°13.0	1550	
197CTD	25.04.2005	09°33.9	13°12.7	1477	
199CTD	25.04.2005	09°33.0	13°12.9	1473	
200ROV_P-1	25.04.2005	09°32.99	13°12.92	1469	Aphyric pillow basalt. Vesicles: 5% up to 10 mm. Extensive Mn-Oxide coating. Patch of glassy crust, partially palagonitized.
200ROV_P-2	25.04.2005	09°32.96	13°12.80	1523	Pillow basalt. Olivine phenocrysts: <1% up to 1 mm. Vesicles: 5%, irregular shapes, up to 10 mm. Extensive Mn-oxide coating, 1 mm palagonitized glass crust.
200ROV_P-3	25.04.2005	09°32.90	13°12.72	1505	Piece of lava lobe roof. Aphyric. Top surface shows mm-scale scotch marks (parallel to flow direction) and cm-scale flow folds (long axis normal to flow direction). Fresh glass crust (3 mm). Vesicles: 10% round and tubular. Lower surface: irregular stalagmite texture.
200ROV_P-5	25.04.2005	09°32.93	13°12.51	1494	Bright orange Fe-oxihydroxide mud and few small pieces of semi-lithified material.
200ROV_P-6	25.04.2005	09°32.92	13°12.53	1496	Piece of 6 cm thick aphyric lava crust. Glass crust (1-2 mm) with minor Mn-oxide coating. Upper layer is vesicle-free; lower 3 cm contain 20% tubular vesicles (up to 3 cm long and 0.5 cm wide) normal to surface with regular spacing.
200ROV_P-7	25.04.2005	09°32.88	13°12.55	1495	Semi-lithified pieces of Fe-oxihydroxides; crude layering, no apparent Mn-oxides.
200ROV_P-12	25.04.2005	09°32.71	13°12.55	1495	Section of aphyric pillow basalt. Vesicles: 10% round to irregular, locally coalesced (up to 2 cm). Glass crust (2 mm) with Mn-oxide coating and biological colonization.
201VSR-1	25.04.2005	09°31.98	13°12.21	1551	Pelagic sediment.
202VSR-1	25.04.2005	09°32.49	13°12.71	1512	Basalt glass.
203VSR-1	26.04.2005	09°32.72	13°12.65	1509	Basalt glass.
204VSR-1	26.04.2005	09°33.01	13°12.36	1518	Basalt glass.
205VSR-1	26.04.2005	09°33.5	13°12.53	1497	One pillow fragment with glass crust and several glass chips.
206CTD	26.04.2005	09°33.3	13°12.5	1469	
207ROV	26.04.2005	09°32.9	13°12.5	1510	

Station	Date	Lat. (S)	Long. (W)	Depth (m)	Rock description
208CTD	26.04.2005	09°32.8	13°12.6	1501	
209GTV-1	26.04.2005	09°32.86	13°12.52	1511	Glassy volcanic crust; partially altered.
209GTV-2	26.04.2005	09°32.86	13°12.52	1511	Orange to brown semi-lithified Fe-oxihydroxides; numerous pieces of fragile crusts up to 15 x 10 x 1 cm; fine grained.
210VSR-1	26.04.2005	09°33.83	13°12.50	1482	Several pieces of aphyric basalt, abundant glass shards.
211VSR-1	26.04.2005	09°34.13	13°12.55	1488	Fresh aphyric basalt glass.
212VSR-1	26.04.2005	09°34.55	13°12.40	1413	Some glass chips.
213GTV-1	27.04.2005	09°32.83	13°12.55	1513	Basalt glass chips.
213GTV-2	27.04.2005	09°32.83	13°12.55	1513	Fe-oxihydroxide crusts.
213GTV-3	27.04.2005	09°32.83	13°12.55	1513	Thin (<1 mm) sheets of sulfides.
214GTV-1	27.04.2005	09°32.84	13°12.54	1511	Fresh aphyric basaltic glass chips.
214GTV-2	27.04.2005	09°32.84	13°12.54	1511	Fe-oxihydroxide crusts.
214GTV-3	27.04.2005	09°32.84	13°12.54	1511	Thin sheets (<1 mm) of sulfides.
215OFOS	27.04.2005	09°32.1	13°12.9	1550	
216CTD	27.04.2005	09°32.8	13°12.9	1509	

\*: Sample position accurate within +/- 1 to 2 m relative to the beacon set at 4°48,559'S; 12° 22,413'W

Abbreviations for sampling equipment

GTV: TV grab samples

ROV\_AC: Accidentally sampled material during ROV dive due to seafloor contact

ROV\_P: Sample taken on position with ROV manipulators

VSR: Vulkanit Stossrohr (wax-corer for volcanic rocks)

ROV-PC: Particle Catcher deployed by ROV

## 1.7. Concluding Remarks

Cruise M64/1 was a very successful cruise without any major technological or logistical problems. The cooperation between the crew and the scientists resulted in a large number of successful sampling stations and numerous excellent geologic and biologic samples. Several outstanding results have been obtained like the sampling of the hottest vents known from the Mid-Atlantic Ridge, the finding of the southernmost vent field on the Mid-Atlantic Ridge, and the definition of several new targets for further exploration in this area. Consequently, M64/1 has made important new contribution to our understanding of the volcanic, hydrothermal and biologic processes on a slow-spreading axis and it also paved the way for further cruises during the lifetime of SPP 1144.

## 1.8. References

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# Appendix to Cruise Report M64/1

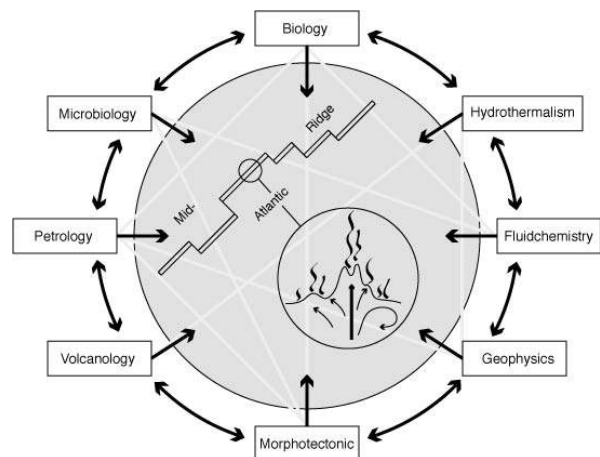
## MARSÜD 2

2 April – 3 May 2005, Mindelo (Cape Verde) – Fortaleza (Brazil)

K. Haase, C. Flies, S. Fretzdorff, O. Giere, A. Houk, S. Klar, A. Koschinsky, J. Küver, H. Marbler, P. Mason, N. Nowald, C. Ostertag-Henning, H. Paulick, M. Perner, S. Petersen, V. Ratmeyer, W. Schmidt, T. Schott, M. Schröder, R. Seifert, C. Seiter, J. Stecher, H. Strauss, J. Süling, D. Unverricht, M. Warmuth, S. Weber, U. Westernströer

Project Leader: Karsten Haase

- ROV station protocols (36 pages)
- Water column samples (1 page)
- Fluid samples (1 page)
- List of zoological samples (8 pages)
- Sample list geology (7 pages)



Meteor M64/1 ROV-Protokolle

Station No:	108 ROV	<b>ME-64/1</b>	
Segment (area):	5°S, Target:	Hydrothermal fields Turtle Pits, Wideawake Mussle Field	
Date:	8. April 05	<b>ROV dive 36</b>	
<b>Time (hh:mm:ss)</b>	<b>CODE</b>	<b>Notes</b> (use "<ctrl>" to add date and time!)	<b>SAMPLE</b>
9:12:21		Begin of station at 4°48.59'S 12°22.40'W, ROV in water	
9:31:49		ROV at 184 m; system tests; Fluid sampler system flushed during the way down	
9:51:03		Fluid pump off	
9:57:12		ROV system failure	
10:06:41		System rebooted, still problems, no transmission of ROV cameras	
10:36:14		ROV system testing, depth 250 to 300 m	
10:42:22		going down, 380 m	
10:59:30		865 m	
11:21:12		ROV system failure	
11:32:34		ROV still non functional	
12:04:54		ROV still non functional	
12:15:28		ROV back online	
12:15:47		ship position: 4°48.59'S 12°22.35'W	
12:19:56		system failure?	
12:22:29		system failure	
12:52:55		ROV still non functional	
13:52:45		ROV still in ca. 1000m - not working	
14:13:42		ROV reload - actual depth 974m - cameras are working	
14:31:51		ROV is going down	
14:44:32		1360 m, going down, 4°48.58'S / 12°22.38'W, HS 2990m	
15:08:10		2000 m, going down, 4°48.60'S / 12°22.35'W, HS 2998m	
15:35:15		2730m, going down, 4°48.58'S / 12°22.36'W, HS 2999m	
15:45:20		bottom view, slightly sedimented lava	
15:47:12		lava tallus slightly sediment covered	
15:48:58		sheet flows, lava tallus, 4.6 m above bottom	
15:50:19		small particle flux	
15:50:21		fracture or little fissure N-S orientated	
15:52:36		sedimented area	
15:54:47		rock fragmets sticking out of the sediment	
15:56:27		orthogonal grid pattern	
15:56:32		highly sedimented sheet flows	
15:59:08		sheet flows partly sedimented, still 4.6 m above bottom	
15:59:12		lobated flows, yellow patch	
16:01:18		jumbled sheet flows, no sediment; shrimp	
16:02:39		shrimp in water column	
16:04:13		jumbled sheet flows, no sediment, 4°48.60'S / 12°22.37'W, HS 2997m	
16:06:31		jumbled sheet flows, no sediment	
16:08:27		small particle flux	
16:09:36		lobate flows sightly sedimented	
16:10:05		lobate flows covered with sediment; fish	
16:11:03		shrimp in water column	
16:12:01		80% sediment cover	
16:13:17		jumbled sheet flows partly sediment covered	
16:14:02		jumbled sheet flow no/little sediment	
16:17:34		slope with jumbled sheet flows coevred with sediment - top at 2995m going down slope	
16:18:49		bottom at 2992m	
16:20:50		flat sedimenetd striated surface	
16:23:29		jumbled sheet flows partly sediment covered	
16:24:29		sedimented area; fish	
16:26:09		jumbled sheet flows only slightly sedimented	
16:29:18		jumbled sheet flows and sedimented area	
16:31:14		sheet flows and striated surface areas	
16:31:58		Aktillie or seestar	
16:33:58		jumbled sheet flows only slightly sedimented	
16:34:56		lobated flows mixed with sheet flows partly sedimented	
16:36:29		flow contact: sedimented sheet flows and above lobated flow	
16:37:03		pillow basalts at 2996m; ship: 4°48.60'S / 12°22.39'W, HS 2998m	
16:38:33		sedimented area	
16:39:47		jumbled sheet flows covered with sediment	
16:40:07		orthogonal grid pattern	
16:40:52		jumbled sheet flows covered with sediment	



Meteor M64/1 ROV-Protokolle

Station No:	108 ROV	<b>ME-64/1</b>	
Segment (area):	5°S, Target:	Hydrothermal fields Turtle Pits, Wideawake Mussle Field	
Date:	8. April 05	<b>ROV dive 36</b>	
<b>Time (hh:mm:ss)</b>	<b>CODE</b>	<b>Notes</b> (use "<ctrl>" to add date and time!)	<b>SAMPLE</b>
16:42:28		jumbled sheet flows only slightly covered with sediment	
16:44:22		sedimented area	
16:44:45		jumbled sheet flows only slightly covered with sediment	
16:45:12		lobated flow and pillow lava	
16:46:00		jumbled sheet flows only slightly covered with sediment	
16:47:16		2 anemones; gorgonaria (Koralle fadenförmig)	
16:48:52		sedimented basin-like structure	
16:49:50		swirls, partly sediment covered	
16:50:44		sheet flows	
16:50:59		striated sheet flows only slightly covered with sediment; hydrozoa on rock	
16:52:36		very clear water - no particle flux	
16:53:06		jumbled sheet flows only slightly covered with sediment	
16:53:32		mussle field / GAP is working now --> flying towards the british hydrothermal position	
16:55:05		mussle field in sheet flow	
16:55:41		holothurie in mussle field	
16:55:59		sedimented area	
16:57:27		flow contact?	
16:58:05		jumbled sheet flows only slightly covered with sediment	
17:00:28		jumbled sheet flows only slightly covered with sediment	
17:02:52		lost bottom view, 8.9m above see floor	
17:05:25		jumbled sheet flows covered with sediment	
17:06:05		jumbled sheet flows only slightly covered with sediment	
17:06:39		gorgonarie	
17:07:05		thruster dust	
17:08:01		jumbled sheet flows only slightly covered with sediment	
17:09:08		flow contact sheet flow above sedimented jumbled sheet flow; mussle patch	
17:09:10		orthogonal grid pattern	
17:09:46		swirls, partly sediment covered	
17:10:06		mussle patch above jumbled sheet flow	
17:11:10		thruster dust	
17:12:30		jumbled sheet flows only slightly covered with sediment	
17:13:51		jumbled sheet flows only slightly covered with sediment	
17:15:36		jumbled sheet flows, no sediment	
17:15:44		mussle field	
17:16:45		red thruster dust	
17:17:45		small water current	
17:18:53		shells, dead calyptogena, clams	
17:21:24		ROV parking on shell bed	
17:24:01		sheet flow	
17:24:48		red thruster dust	
17:26:27		ROV flying again	
17:27:19		inactive chimney; mussle patch	
17:27:39		fissure behind chimney - steep slope	
17:30:09		jumbled sheet flows covered with red sediment	
17:30:17		inbetween jumbled flow shell beds	
17:31:56		inbetween jumbled flow shell beds	
17:32:17		inactive chimney, on the bottom mussle pach (dead and alive individuals)	
17:33:43		shell beds / dead and alive?	
17:34:59		inactive chimneys	
17:37:20		bacterial mats	
17:38:12		broken peaces of chimneys	
17:40:22		mussle beds - alive	
17:40:41		thruster dust	
17:41:36		lava flow contact; lobated flows above sheet flows, chimney fragments; in fissures mussels	
17:43:57		Crab	
17:47:10		trying to set hydroacoustic marker (4°48.591'S / 12°22.397'W)	
17:49:46		hydroacoustic marker have been set	
17:51:22		start fluid sampling at 6 m above sea floor	
18:00:38		valves for fluid sampling open	
18:01:00		positioning of hydroacoustic marker	
18:02:08		opening bottle 11	

Meteor M64/1 ROV-Protokolle

Station No:	108 ROV	<b>ME-64/1</b>	
Segment (area):	5°S, Target:	Hydrothermal fields Turtle Pits, Wideawake Mussle Field	
Date:	8. April 05	<b>ROV dive 36</b>	
<b>Time (hh:mm:ss)</b>	<b>CODE</b>	<b>Notes</b> (use "<ctrl>t" to add date and time!)	<b>SAMPLE</b>
18:03:15		opening valve for bottle 11 fails	
18:12:00		opening valve for bottle 11 fails	
18:12:56		Start ascent of ROV from 2992 m depth	

Meteor M64/1 ROV-Protokolle

Station No:	114 ROV	ME-64/1		
Segment (area):	5°S, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)			
Date: 9. to 10. April 05			ROV dive 37	
Time (hh:mm:ss)	Notes (use "<ctrl>" to add date and time!)	CODE	SAMPLE	MARKER
17:13:17	Begin of station at 4°48.61'S 12°22.49'W, ROV in water			
17:13:46	Start ascent of ROV from 2992 m depth			
17:33:23	ROV at 4°48.581'S 12°22.410'W, 250 m deep			
17:38:24	test of the fluid pumping system went OK			
17:49:26	ROV at (GAPS failure), 750 m deep			
17:59:37	ROV at (GAPS failure) 1000 m deep			
18:35:21	ROV at (GAPS failure) 2000 m deep			
19:08:38	bottom contact (ship is at 4°48.57 / 12°22.41; HS 2998 m) altimeter 30 m			
19:09:17	bottom sight, sedimented sheet flows, partly jumbled, heading 290			
19:12:02	ROV trying to home in on beakon, ROV depth = 2991 + 5 m alt			
19:18:56	ROV is turning to East, jumbled flows			
19:20:30	moving toward 100 over lobate flows and jumbled flows, slight sediment cover			
19:21:37	baterial mats, high particle flow in water column to the east			
19:22:56	curly flows and whirls (depth 2984+8)			
19:24:06	lobate flows			
19:26:34	hovering over lobate flows			
19:30:50	sheet flows (head 110, depth 2987+5)			
19:33:49	moving forward to 120 over curly flows			
19:35:17	turning to 326, than back to			
19:41:28	head 320, jumbled flows			
19:45:59	lobate flows, trying to home in beakon?			
19:49:23	ship is at 4°48.61 / 12°22.34, HS 2996 m			
19:52:04	ROV is at the same (unknown) position, depth 2986+5			
19:53:26	moving to SE, depth 2986+5			
19:55:04	turning north, fish, sml pressure ridge			
19:55:47	ropy flows, with sediment dusting			
19:56:49	sheet flows, sediment pathces, heading 320			
20:00:59	sitting, on pillows to labate flows			
20:02:23	skylights in lobate flows, turning to SE, headin 140			
20:14:38	hovering over pillows to lobate flows, depth 2986+4			
20:16:36	lobate flow			
20:18:55	lobate flow partly covered with sediment			
20:21:42	sheet flows and lobate flows			
20:24:51	jumbled sheet flows			
20:26:22	homer signal identified - ROV is flying to that position			
20:29:32	sheet flows and lobate flows, flying to the west			
20:31:19	jumbled sheet flows in contact with sedimented sheet flows (N-S orientated)			
20:34:08	orthogonal patches in sediment			
20:37:36	thruster dust			
20:40:08	orthogonal patches in sediment			
20:42:48	mussles? Fissure, steep slope			
20:43:08	old sulfides			
20:44:40	fish			
20:44:55	sheet flows, westside or northside ? of the active hydrothermal field?			
20:45:35	homer appears, temperature anomaly of 0.1°C			
20:49:21	sitting next to homer and calibrating position, massive sulfide talus but also abundant ropy basalt that looks similar			
20:50:14	widespread hydrothermal sediment, shrimp, vent fish; large particle anomaly			
20:57:53	autobrecciated lava surface with few shells? To the west of the marker			
21:00:17	turning in order to look around			
21:01:18	2991 m in shells, we want to go 20 m N and 20 m west			
21:03:20	steep morphology, talus, fractures with collapsed pits in otherwise sheet flows,			
21:05:19	thrusterdust, heading north along this fracture; are these the turtle pits??			
21:09:42	autobrecciated jumbled flows, 2988+3, head 009			
21:12:32	stopped at contact between fracture and massive jumbled flows (pressure ridge?)			
21:13:13	thrusterdust			
21:15:43	turning south again, the two sulfides may have been those in the north and not in the west!			
21:17:52	taking fotos at small pit			
21:18:47	moving south, sheet flows with 2-3 m fracture, fracture is widening			
21:20:44	along eastern edge of widening fissure, shrimp			
21:24:54	slowly moving south, head 190, depth 2987+4			
21:26:09	at homer, to the west, taking Niskin bottle			
21:30:22	taking Niskin bottle number 1		114ROV-1	
21:33:58	finished sampling, sampling box closed			
21:34:29	moving further south along eastern edge			
21:37:24	black smoke ahead in the pit, going down into the pit			
21:40:08	black smoker 1 m high, at the bottom of the pit, slowly moving "smoke", depth 2991 m			
21:48:25	taking pictures			
21:50:13	Niskin bottle 3 closed		114ROV-2	

Meteor M64/1 ROV-Protokolle

Station No:	114 ROV	ME-64/1		
Segment (area):	5°S, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)			
Date: 9. to 10. April 05			ROV dive 37	
Time (hh:mm:ss)	Notes (use "<ctrl>" to add date and time!)	CODE	SAMPLE	MARKER
21:51:44	flying above the black smoker			
21:53:26	bacterial mats at the bottom of the smoker			
21:54:07	shrimps sitting on the smoker			
21:59:02	fluid pumping system turned on, rotate valves, no connection??? At least no feed back from valves			
22:01:16	pump turned off			
22:01:47	software reset, pump on, pump off, system not functioning			
22:07:47	ROV needs to reset part			
22:15:52	in front of other smoker, nice pics			
22:16:10	start to set marker M2			
22:21:37	Marker 2 released			
22:24:14	vent crab, around edge to get a closer look at this smoker			
22:25:23	fish, macrouridae			
22:27:36	the smoker seems to be boiling, vapor bubbles visible			
22:31:23	possibly vapor and brine phase at same vent			
22:34:00	turning to south to investigate larger smoker in the south			
22:38:08	right in front of large chimney spire			
22:39:44	what height? Approx. 9m			
22:45:14	on southwestern side of spire, taking pictures			
22:53:14	fauna consist mostly of shrimps (three species?) and bythogaida. No molluscs, sparsly anemona			
22:55:45	vent crab eats shrimp			
22:59:43	shrimp patch at the smoker			
23:00:45	zoom in at the shrimp patch			
23:02:22	starting to work with the temperatur sensor within the somkers's fissure			
23:10:16	try to inject the sensor within a fissure			
23:12:11	increasing T= 4°C			
23:18:58	second measurement , increasing T =5,7			
23:25:11	difficult to handle the tool, T-handle insufficient			
23:27:19	slowly moving to the south, depth 2986+4			
23:28:47	exploring along fissure			
23:31:32	western waal of fissure, sheet flows on top, sedimented			
23:32:28	turning to the north, abundant oxidized sulfide talus, there is an entire sulfide mound			
23:40:08	moving along eastern edge of fissure, basalt with Fe-staining			
23:42:13	fish (bathytide)			
23:50:36	accident sampling of sulfides (hit structure)			
23:54:06	moving west, jumbled sheets, few empty shells			
23:58:18	heading back north, large logs of fallen sulfide structures			
23:59:53	the sulfide needle is in the background, same one we saw on the first day (to the north)			
0:01:06	snail shells?			
0:04:14	pilot change			
0:13:00	still at same position, looks like shimmering water			
0:21:00	still at same position, inactive smoker (coiled shape) straight ahead to NE (69°)			
0:34:00	turning ROV, looking south (185°), large boulders, covered with hydrothermal sediment			
0:37:17	start moving south (197°), short distance, talus			
0:41:01	looking SSE (127°) towards "southern tower" (yet informal name)			
0:46:30	slowly approaching "southern tower"			
0:47:36	chimney appears to have a smaller diameter at base than higher up			
0:48:00	thick black smoke rising up from base of large chimney			
0:54:00	thick black smoke coming from relatively small opening at base of "southern tower"			
0:56:24	many shrimp sitting at small opening			
1:00:00	still close to "southern tower", depth: 2990m, reading ROV 3.2 m above ground			
1:02:00	ROV very close to small opening, high T sensor reads up to 250 °C			
1:07:00	starting to move high T sensor into fluid for testing function			
1:09:20	grip of T-handle not optimal			
1:10:00	still operating high T sensor			
1:17:00	grip of sensor still not optimal			
1:18:00	grip now optimal, moving towards fluid discharge			
1:26:00	"excellent sampling" (ROV touches chimney)			
1:30:00	looking direction 305°: M2 marker at depth			
1:32:28	trying once more to move high T sensor into fluid			
1:37:00	very difficult operation, maximum T measured: 56°			
1:37:30	trying the same measurement at top of "southern tower"			
1:41:00	announcing to take a photo mosaic of chimney			
1:42:25	several individual outlets for black smoke, like small flutes			
1:43:40	laser pointer on			
1:47:30	photomosaicing terminated			
1:48:00	moving E (around 10 m), then north towards smaller chimneys, there: test high T sensor			
1:51:38	moving high T sensor (2987.5 m , 1.2 m above ground)			
1:53:11	testing high T sensor at small needle like chimney, not successful			

Meteor M64/1 ROV-Protokolle

Station No:	114 ROV	ME-64/1		
Segment (area):	5°S, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)			
Date: 9. to 10. April 05			ROV dive 37	
Time (hh:mm:ss)	Notes (use "<ctrl>" to add date and time!)	CODE	SAMPLE	MARKER
1:53:15	two large fishes (bathytidae)			
1:57:42	ROV moving out towards east and south, turning around, then second try			
2:09:35	large chimney coming into sight, ROV approaching for testing high T sensor			
2:11:30	starting photomosaicing of large chimney (may be a second one)			
2:13:25	possible second chimney looks to have smaller diameter, also different top (?)			
2:14:34	large chimney is the same, marker M2 clearly visible next to chimney			
2:16:15	another test/try to test high T sensor			
2:17:45	approaching several discharge sites with high T sensor			
2:27:00	high T sensor test successful, T measured up to 157°, however short failure			
2:28:41	searching for discharge site of gas bubbles			
2:35:39	several discharge sites of black smoke next to marker M2			
2:45:30	high T sensor back to holding position on ROV			
2:52:50	13.9 m above ground, still inside thick plume			
2:53:00	high T sensor stowed away, partly broken (?)			
2:54:00	ROV moving out of plume and then return to black smoker			
3:00:45	ROV moving first towards north, then a turn towards west, returning to chimney			
3:03:00	old chimney structures, the large inactive smoker which we saw during first dive			
3:05:35	chimney structure now named TWIN TOWERS			
3:10:15	moving direction 300°, still inside smoke at 9.5m above ground			
3:10:54	acoustic marker in sight (direction 300 degrees)			
3:13:00	directly above acoustic marker			
3:14:00	moving towards 235°, shell beds			
3:15:00	sulfide mound, brownish, yellow and whitish crusts			
3:17:00	pilot change			
3:18:00	black smoke in the back of sulfide mound			
3:19:35	ROV is now very close to large chimney ("southern tower")			
3:20:42	moving towards discharge site at base of chimney			
3:24:49	looking straight west, black smoke blowing towards us			
3:27:15	Niskin bottle 3 closed, not directly in black smoke		114ROV-3	
3:30:00	will start to collect samples for geology/biology			
3:34:40	jumbled sheets			
3:35:30	moving SW, large pit structure, old chimney structures			
3:37:20	black smoker ahead			
3:39:00	sheet flow with shell debris			
3:40:39	large chimney again (informably named "southern tower")			
3:45:50	trying to grab a small sulfide piece from the base of chimney (near black smoker)			
3:50:00	sampling of chimney piece rather difficult			
3:55:00	broken off piece fell on front table of ROV (later recovered)		114ROV-4A	
4:02:15	try to move chimney sample from grid into sample box			
4:06:45	cannot move sample from grid, will stay there			
4:09:39	net for biological samples taken out of sample drawer, same chimney as 4A, rubble fell into net		114ROV-4B	
4:20:00	larger piece (same piece as before) of chimney on top of ROV arm		114ROV-5	
4:27:30	chimney piece fallen off ROV arm, part of it recovered, placed on front grid (later recovered)			
4:40:45	moving west, old sulfide chimneys at TWIN TOWERS, sulfide talus			
4:44:00	acoustic marker in sight (direction 240°)			
4:48:30	near "southern tower", wanting to collect another chimney piece			
5:00:00	so far, sampling of chimney not successful, trying to use net for support, two different samples transferred to		114ROV-6	
5:14:00	net with sulfides from the upper part of the sulfide chimney successfully transferred to sample drawer		114ROV-7	
5:18:00	trying to secure the high T sensor on grid			
5:24:00	sensor secured			
5:26:58	sampling finished, contact acoustic marker, then sonar scan			
5:31:47	ground weight from ABE in sight			
5:47:45	second sonar scan			
5:55:00	ROV starting to ascend			
8:42:04	ROV on deck; END of station: 4°48,60' S; 12°22,39' W			

Meteor M64/1 ROV-Protokolle

Station No:	<b>123 ROV</b>	<b>ME-64/1</b>	Call ROV at Tel# 528		
Segment (area):	4°48.6'S/12°22.4'W, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)				
Date: '11. April 05	<b>Dive 38</b>				
Time (hh:mm:ss)	Notes (use "<ctrl>" to add date and time!)	CODE	SAMPLE	MARKER	
8:49:27	ROV goes into the water at 4°48.63S; 12°22.39W (ship coordinates)				
8:56:24	ROV is going down				
10:04:00	ROV at 1750 m, 4°48.573'S / 12°22.410'W (GAPs)				
10:26:55	Testing of valve starboat side failed at 870m; valve portside failed at 1990m				
10:34:24	ROV at 2500 m, 4°48.570'S / 12°22.395'W (GAPs)				
10:52:14	bottom view				
10:52:37	lightly sedimented pillow lavas and lobate flows				
10:57:26	ROV is moving south for 90 m in order to locate Turtle Pits				
10:59:12	lobate flow/jumbled flow				
10:59:51	8 m over ground, hard to make out and seafloor features				
11:00:51	lobate flow/jumbled flow				
11:01:51	lobate flow, sedimented				
11:02:44	lobate flow, sedimented; 2988 m				
11:04:00	2 fishes Ophidiiformes				
11:05:29	lobate flow, sedimented				
11:06:16	there is a discrepancy between DWL and GAPS, change of course due WEST to locate the beacon				
11:07:50	beacon: 4°48.577S 12° 22.402W ; GAPS position read from WinGPS. 2990 m. 25 m SE away from the position that was determined during ROV 114				
11:09:49	inactive smoker with abundant mussle-shell beds at the edge of a small cliff				
11:17:08	remaining at station in order to obtain an accurate position				
11:21:09	now: 4°48.551S 12°22.417W; GAPS jumps around a fair bit.				
11:23:21	Octopus sitting right at the beacon				
11:26:21	Octopus show!				
11:31:49	Octopus disappears				
11:32:32	thruster dust				
11:33:58	cameras found octopus again				
11:42:46	still parking to get exact position				
11:45:50	octopus is gone; beacon and inactive smoker are aligned due south (180), cliff is going down to the East				
11:51:07	4°48.557S 12°22.409W is the exact position of the beacon according to the result of the extended survey				
11:56:59	octopus just visible hiding behind the inactive smoker				
12:00:26	still parking at beacon, octopus gone				
12:02:22	jellyfish				
12:05:00	shrimp				
12:06:39	GAPs is very unstable, probably sonar is disturbing GAPs signal				
12:15:00	ADCP and beams off				
12:17:30	leaving the homer flying to the south to enter the valley towards the east				
12:19:30	mussle beds, on basalt covered by brown and white hydrothermal sediment				
12:20:53	sulfide mound, brown and white surfaces				
12:21:53	inactive chimney adjacent to mound				
12:22:13	shrimps, view to the west				
12:23:10	inactive mound				
12:25:10	reached 9 m high southern tower black smoker				
12:25:57	M2 marker black smokers				
12:29:11	looking S, the southern tower is located due 160 degrees from the M2 site				
12:30:30	going south by 10 m				
12:31:34	inactive smoker, hydrothermal sediment mussle beds				
12:33:04	flat surface of sheetflow? Covered with hydrothermal sediments				
12:34:05	sulfide mound, brown and white surfaces				
12:35:27	the sulfide mound is actively discharging black smoke! This is a new active location, smoke is going up straight				
12:38:56	smoker is approximately 1 m high and 0.70 m wide, sitting on top of the sulfide mound (laser points are 20 cm apart)				
12:39:45	4°48.569S 12°22.419W				
12:41:39	smoking orgelpipes, Feoxides and bacterial mats, beehive structures, small and big shrimps (rimicaris and chorocaris), two vent crabs				
12:46:53	foto stitch of the whole smoker				
12:49:33	still on the northside of the smoker				
12:54:33	marker placed on the bottom of the northside of smoker 4; 4°48.571S 12°22.410W				plate marker
12:59:50	flying around smoker to the southernside				
13:01:10	8 smoking orifices				
13:02:48	vapour bubbles ----> critical boiling (ca. 407°C at that depth)				
13:04:53	Svens filter and temperature sensor will be tested at the vapour bubbles				
13:16:01	still trying to deploy the filter system				
13:23:20	sampling temperature and smoke directly in the chimney	123ROV-1		filter and temperature	
13:25:17	parts of the smoker falling down				
13:28:34	chimney is wide open now --> ideal for fluid sampling				
13:34:35	Niscine white bottle 1 filled next to the smoker	123ROV-2		water in niscine bottle	
13:35:41	Niscine bottle 3 filled directly above the venting	123ROV-3		water in niscine bottle	
13:44:48	trying to grap a sample with rick master and put them into the net				
13:50:25	samples taken from the east-south eastern wall of the smoker; 2986m ROV depth; 4°48.578S 12°22.404W	123ROV-4		sulfides	
13:59:57	exchange of pilots				
14:08:12	resume thw survey, course due south for approx. 20 m				

Meteor M64/1 ROV-Protokolle

Station No:	123 ROV	ME-64/1	Call ROV at Tel# 528	
Segment (area):	4°48.6'S/12°22.4'W, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)			
Date: '11. April 05	<b>Dive 38</b>			
Time (hh:mm:ss)	Notes (use "<ctrl>" to add date and time!)	CODE	SAMPLE	MARKER
14:08:54	jumbled sheet flow ridge , cliff facing to the west (downthrough side)			
14:11:01	traveling along cliff, little sediment cover, floor of trough is probably deeper than 10 m			
14:12:58	end of 20 m ROV continues for another 10 m to the south			
14:15:27	end of 10 m change course to the East			
14:15:58	fish Ophidiiformes			
14:16:11	sheet flow, mainly also ropy			
14:17:06	course 10 m due East			
14:17:42	thruster dust			
14:18:36	4 m due East			
14:18:56	fish Ophidiiformes in water column			
14:19:26	ropy sheet flow			
14:21:00	course 10 m due North			
14:21:20	flat sheetflow surface, whorl structure, sediment cover			
14:22:32	contact flat sheetflow structure to jumbled			
14:22:54	continue 10 m to the N			
14:23:22	jumbled sheet flow, no sediment cover; local white patches			
14:25:53	continue 10 m to the N, two fishes Ophidiiformes			
14:27:03	jumbled sheet flow, no sediment cover			
14:28:01	continue 10 m to the N			
14:29:41	change course due West			
14:29:57	crossing cliff top at 2989 m			
14:31:04	chimney structure ahead: the SOUTHERN TOWER			
14:31:56	floor at 2992 m			
14:32:31	active discharge of black smoke at the base + all along the way up to the top			
14:35:23	start of biological sampling program			
14:41:03	black smoke is surrounding the ROV			
14:44:55	shrimps are located/sitting in pockets close together			
14:45:46	single brown crab			
14:52:50	biological sampling on the northern side of the tower / heading 215			
15:01:17	biological sampling with successful: net full of shrimps	123ROV-5	shrimps / biology	
15:09:29	biological sampling with net: target crab first try: crab escaped			
15:11:39	biological sampling: shrimp in net	123ROV-6	shrimps / biology	
15:19:29	sampling at this site finished (for today...), next target: active chimneys at marker M1 for fluid sampling using the fluid sampling equipment			
15:28:37	course S to SE towards the active smoker at the M1 marker			
15:30:31	sulfide mound marker M1 in sight			
15:34:15	black smoke with abundant gas bubbles! Smoke is going straight up just like during our first visit in the morning			
15:42:58	temperature sensor deployed and moved into the mouth of the artificially enlarged smoker chimney			
15:46:07	T sensor peaks at 402°C; pump switched on			
15:47:39	404°C			
15:47:54	405°C			
15:48:19	406°C			
15:48:35	405°C	123ROV-7	fluid sample	
15:48:45	414°C			
15:49:31	438°C ??; fluid tube ruptured			
15:49:48	end of sampling exercise;			
15:50:18	pump is off			
15:54:40	loss of small band from orion manipulator			
16:00:59	sonar survey at 10 m above the ground starts			
16:21:31	try to sample basalt			
16:25:30	start sampling with Orion, jumbled sheet flow			
16:26:39	successful lava sample placed in tool box	123ROV-8	lava	
16:29:53	(c?) fish Ophidiiformes Ophidiiformes			
16:30:19	red deep sea shrimp			
16:30:44	thruster dust			
16:33:17	lineated surface			
16:33:18	single mussels			
16:33:34	Ophidiiformes			
16:35:31	transition from stratified surface to jumbled sheet flow			
16:35:54	shells			
16:36:21	sulfate mound with several (ca. 6) inactive smoker			
16:38:10	offset of DVL, thus going back to homer			
16:42:08	homer found, Benthoctopus still around			
16:46:25	trying to grasp a sample from inactive chimney			
16:50:20	sample taken at homer site	123ROV-9	piece of inactive chimney	
16:52:16	geological and biological sampling completed - flying back to marker 1 to fill Niscine bottle			
16:55:09	mussle patch			
16:59:13	marker M1 in sight, crossing mussle patch			
17:00:05	active discharge of black smoke			
17:02:43	thruster dust			
17:05:28	start of operations for He-fluid sampling			
17:15:20	preparations for He sampling on-going; Cu-tube placed inside of the actively discharging black smoke, very impressive sampling procedure			



Meteor M64/1 ROV-Protokolle

Station No:	<b>123 ROV</b>	<b>ME-64/1</b>	Call ROV at Tel# 528	
Segment (area):	4°48.6'S/12°22.4'W, Target: Turtle Pits Hydrothermal field (sampling, marker, fluids)			
Date: '11. April 05	<b>Dive 38</b>			
<b>Time</b> (hh:mm:ss)	<b>Notes</b> (use "<ctrl>" to add date and time!)	<b>CODE</b>	<b>SAMPLE</b>	<b>MARKER</b>
17:21:02	He-sampling completed successfully	123ROV-10	Cu-tube with fluid sample for He	
17:23:50	sampling of black smoke with niskin bottle, labelled with 2 yellow markers	123ROV-11	niskin fluid sample	
17:30:10	flying towards the north			
17:31:52	end of dive - ROV is coming up			
17:34:45	off bottom			

Meteor M64/1 ROV-Protokolle

Station No:	125 ROV	ME-64/1	Call ROV at Tel# 528		
Segment (ar	4°48.6'S/12°22.4'W, Target: Wideawake Musselbeds (sampling, marker, fluids)				
Date: 12. Ap	Dive 39				
Time (hh:mn)	Notes	CODE	SAMPLE	MARKER	
8:33:29	Begin of station at 4°48.6'S 12°22.4'W				
10:23:48	2740 m				
10:33:40	seafloor, 4°48.613S 12°22.357'W GAPS coordinates; 2988 m				
10:34:58	lightly sedimented lobate lavaflow				
10:40:11	fish				
10:46:42	course 20 m due south				
10:47:05	encounter of plastic chain dislodged from TV Grab (from Oktopus) tied to seafloor by weight of "karabinerhaken"				
10:48:46	sheet flow with whorls				
10:49:16	lobate sheet flow				
10:52:55	some time stationary, now continues over lobate sheet flow				
10:55:43	lobate sheet flow with minor collapse structures				
10:57:26	completed 40 m (fourty) to the south				
10:57:44	change course due East for 20 m				
10:58:29	lobate sheet flow lightly sediments				
10:59:49	collapse pit				
11:00:02	scattered mussle beds, crossing into more jumbled flow morphologies				
11:02:11	shimmering water and live mussels!				
11:02:29	mussels within pockets of basalt sheet flow, Actinia and some limpits on basalt, mussels overgrown by small grey limpits, + abundant grey strings (byssus)				
11:04:00	vent crabs and a few shrimp				
11:05:15	shimmering water				
11:06:04	thruster dust				
11:07:32	sea anemonea, great image close up of the limpets!				
11:08:39	photo stop of ROV at this site				
11:08:58	crab				
11:10:27	polychaete worm (?)				
11:12:37	recognize a temperature anomly of 2.8°C that occurred a few minutes ago				
11:13:31	Mussels covered by limpits and snail egg aggregates				
11:15:20	recognize that the surrounding is jumbled and thrusted sheet flow surface				
11:16:03	Actinia				
11:18:55	field is 2 x 2 m, estimate of max. extent				
11:22:36	sampling innitiated				
11:23:33	temperature occasionally up to 2.9 °C				
11:25:08	shrimp				
11:28:52	sampling with Orion failed beacuse of the instability of rock				
11:29:14	trying sampling with net				
11:38:09	Bathymodiolus colony sampled with net at GAPS: 4°48,611S; 12°22,327'W; 3000m	125ROV-1	mussles with rock pieces		
11:40:38	fish appears				
11:42:07	trying to grap the worm tubes				
11:46:01	worm tubes sampled with Orion at: 4°48,624S; 12°22,355'W; 3000m	125ROV-2	worm tubes		
11:51:22	looking for rock sample to cover the worm tubes and prevent sample loss				
11:57:30	closed niskin bottle marked with one white lable (right side)	125ROV-3	niskin bottle water sample		
11:59:36	basalt sample emplace on top of sample 125ROV-2; 4°48,611S; 12°22,327'W; 3000m	125ROV-4	basalt		
12:03:46	sampling procedure finished				
12:14:54	fyng to the east				
12:15:40	new mussle patch of Bathymodiolus colony - 3 times bigger than the first mussle patch - ca. 1 x more than 10m-15m				
12:18:26	mosaic fotos taken (foto stitching)				
12:18:29	crabs siting in the mussle patch				
12:22:38	lava talus field and jumbled sheet flows; 4°48,629S; 12°22,358'W; 3000m				
12:27:54	foto stitching flying 30m to the west, going back 2m next to the first foto stitch area				
12:34:58	fish				
12:35:41	flying 5 m to the south				
12:36:48	jumbled flows - lava with little white spots (anemone?), slightly covered with sediment				
12:39:01	snail (Phymorhynchus)				
12:42:53	Bathymodiolus colony covered with lots of limpids				
12:43:42	Hydrozoa sitting inbetween the mussle patch				
12:45:37	shimiring water and small temperature anomalies				
12:49:02	anemones				
12:53:53	scyphopolypen				
12:57:24	ROV is parking and temperature rises up to 3.3°C				
13:05:26	Niskin bottle closed (middle bottle; 3 white dots)	125ROV-5	niskin bottle water sample		
13:09:06	rock sampling, sample in basket "lower right", position 4°48.639'S / 12°22.346'W, depth 2986m, basalt is overgrown with Hydrozoa	125ROV-6			
13:15:39	try to take second sample, failed				
13:26:16	thrusterdust, heading south to search for clam field				
13:29:22	few clams sitting in depressions of broken jumbled flows, two live rest shells				
13:32:43	moving further south				
13:35:31	jumbled flows, fauna is decreasing				

Meteor M64/1 ROV-Protokolle

Station No:	125 ROV	ME-64/1	Call ROV at Tel# 528		
Segment (ar	4°48.6'S/12°22.4'W, Target: Wideawake Musselbeds (sampling, marker, fluids)				
Date: 12. Ap	Dive 39				
Time (hh:mn)	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	MARKER	
13:38:28	single Gorgonia				
13:38:53	thrusterdust				
13:40:38	thrusterdust				
13:43:51	moving 10 m to the west, jumbled sheet flows				
13:46:46	gestielter Schwamm in jumbled flows				
13:49:07	hornitos or pressure ridge or small sulfide chimneys				
13:49:36	calyptogena shells				
13:50:34	thrusterdust				
13:50:59	moving 5 m to the west than back to north				
13:52:45	jumbled flows				
13:54:23	back in mussel field				
13:58:50	sitting on top of musselbed, shimmering water, 3.0°C				
14:05:31	1 Calyptogena alive, GAPS: 4°48.631'S / 12°22.359'W, depth 2986m (ROV)				
14:10:51	beginning to sample Calyptogena with net GAPS 4°48.631'S/12°22.359'W, depth 2985m (ROV)				
14:25:49	end of sampling; sample in non-marked net 300µm; Container: 4°48.645'S/ 12° 22.348'W	125ROV-7			
	(ROV) erhöhte Temperatur 3,1°C				
14:32:08	collapsed structure of lobated lava				
14:35:07	10 m to south				
14:39:22	10 m to north				
14:42:22	Mussle patch (Calyptogena); altered basalt with Hyrozoa coating				
14:44:44	thruster dust				
14:44:51	course due East for 10 m				
14:47:03	jumbled sheet flow, no biology				
14:48:11	10 m to East				
14:48:29	mussle field				
14:48:50	young lava flow covering mussle patch? Unlikely since there are more musske				
14:50:27	continue due east, more mussle patches				
14:51:53	HERE is the contact of fresh sheet flow covering the mussle and clams?				
14:52:32	This lava lobe is about 20 to 30 cm thick, flow front, ropy sheet flow, however it is not clear whether it is continuous				
14:55:02	jumbled, brecciated flow				
14:59:41	2987 m going up?, jumbled flow with occational mussle patches				
15:00:21	10 m due East				
15:01:42	jumbled flows with occational mussle patch; 2987 m				
15:03:16	pillowed fresh lava overlying jumbled flow				
15:03:58	lobate flow overlies the jumbled flow				
15:04:43	Brisingidia				
15:06:58	4°48.634S 12°22.341W; BUT the GAPS signal is unstable and jumps, positioning good in the second decimal.... sampling plan: take a sample of this younger lobate flow and of the underlying jumbled flow				
15:15:32	sampling under way				
15:20:03	sampling proves difficult due to fragile, glassy nature of the lava, change of position				
15:23:54	white patches are refelctions of the light on the glassy surface of the lava lobes				
15:24:33	fish: Bythitidae				
15:27:37	sampling for glassy basalt, 2985 m				
15:32:17	sampling on-going				
15:37:24	sampling on-going				
15:43:17	too fresh for sampling?				
15:44:53	rig master comes to the rescue...				
15:46:44	frequently hitting the ground-accidental sampling?				
15:50:39	crab				
15:52:01	thruster dust				
15:52:41	sampling ongoing, "the riffle is not thrown into the wheat field yet..."				
15:55:55	pillow rind textures together with lava lobes (escape texture, rind textures)				
16:03:25	basalt fragment in orion jaws!				
16:04:10	4°48.635'S 12°22.345'W, 2985 m, middle of lower row	ROV125-8	basalt		
16:07:21	sampling continues				
16:11:42	fish				
16:12:09	crossed into the jumbled flow, 2986 m				
16:16:12	using shovel for sampling of lava				
16:19:14	some basalt fragments recovered in the shovel and place on the poarch	ROV125-9	basalt		
16:23:58	some more bassalt fragments recovered and placed in lower row left box	ROV125-10	basalt		
16:26:47	flying to the west in order to obtain fluid samples from diffuse discharge				
16:27:19	mussle patch				
16:29:49	mussle patch				
16:30:02	fish: Bythitidae				
16:31:17	back on fresh lobate lava flow				
16:31:55	small collapse pit?				
16:32:10	fish				
16:34:47	hunting the fish, Ophidiiformes				

Meteor M64/1 ROV-Protokolle

Station No:	125 ROV	ME-64/1	Call ROV at Tel# 528		
Segment (ar	4°48.6'S/12°22.4'W, Target: Wideawake Musselbeds (sampling, marker, fluids)				
Date: 12. Ap	Dive 39				
Time (hh:mn	Notes	CODE	SAMPLE	MARKER	
(use "<ctrl>t" to add date and time!)					
16:35:58	very nice collapsed lobate flow				
16:37:39	collapse lobate lava tounges				
16:38:50	still hunting the fish towards the W-NW				
16:41:52	thruster dust				
16:45:13	collapse lobate lava tounges				
16:47:39	lava collapse structure				
16:50:20	mussle field				
16:50:37	increasing temperature up to 2,9°C				
16:54:12	shimmering water				
16:54:46	start fluid sampling 4° 48,634' S / 12° 22,362' W, 2980 m	ROV125-11	Fluid		
17:00:58	temperature increase up to 3,97° C				
17:02:03	temperature rises up to 4,0°C				
17:09:00	temperature increase up to 4,4°C				
17:10:54	temperatur 4,3°C				
17:11:35	temperature rises up to 15°C				
17:12:12	temperature 16,2°C				
17:12:45	temperature 16,7°C				
17:13:24	start pumping process				
17:14:01	temperature variation 12 to 16 °C				
17:17:03	temperature rises up to 17,2 °C				
17:17:45	temperature 18,0°C				
17:28:50	stop fluid sampling				
17:37:36	problems with fluid sampler handling, sensor tip is twisted too much, doesn't go into holder; leave it on front porche; will try to grab crabs with bionet				
17:41:09	trying to sample crab, first attempt failed, finalla sucesful	ROV125-12	Bio Crab and mussels		
17:48:02	end of crab sampling				
17:53:52	closing last Niskin bottle 4° 48,622' S / 12° 22,384' W, 2987m	ROV125-13	niskin bottle water sample		
18:00:42	diving up, leaving seafloor				
21:46:39	ROV on deck since 20:45				

Meteor M64/1 ROV-Protokolle

Station No:	130 ROV	ME-64/1		Call RC
Segment (area):	4°48.6'S/12°22.4'W, Target: Wideawake Tower (fotoshooting, sampling, marker, fluids)			
Date: 13. April 05	Dive 40			
Time (hh:mm:ss)	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	
8:55:16	Begin of station at 4°48.6'S 12°22.4'W			
10:14:04	ROV at 1500 m			
11:21:51	bottom view			
11:24:36	sedimented lobate lava flows			
11:27:38	170m north of homer, GAPS is out of order			
11:30:29	jumbled flow contact to linedated sheet flows			
11:34:54	linedated flow			
11:35:56	ridge-like structure made-up of jumbled flows			
11:38:16	jumbled flow contact to linedated sheet flows			
11:38:40	jumbled sheet flows			
11:39:36	jumbled flow contact to linedated sheet flows			
11:40:26	still 60 m to fly to homer			
11:42:14	linedated sediment			
11:43:45	jumbled sheet flow			
11:43:55	homer reached			
11:44:18	mussle patches			
11:47:49	4°48,5603S, 12°22,4159W position of beacon (communication from container); GAPS is working			
11:52:00	change over of pilots, ROV stationary			
12:04:59	CDT display out of order			
12:12:15	flying to inactive chimney: "Pinocchio" facing north - foto stop			
12:21:57	"Pinocchio" facing north is located at 8m due 37degree relative to the homer beacon			
12:25:40	2nd inactive chimney reached ("Stalagmite")			
12:30:37	stalagmite is located 14 m due 24° relative to the beakon and 5.5 m high			
12:34:59	moving south crossing mussle bed			
12:37:21	reached M2 active smoker site			
12:39:50	several discharge sites defining an active hydrothermal ridge of approx. 2 m length oriented in E-W direction; these are located at approx. 3 m south from the M2 marker			
12:40:48	Marker M2 is located 22 m due 23° relative to the beacon			
12:44:16	black smoke plume is discharging towards the north			
12:49:16	moving across mussle patch due 300°			
12:49:37	change to south; mussle patch is extensive, covering jumbled sheet flow surface that is covered by brown hydrothermal sediment			
12:53:28	position of the TV-grab?, 34 m in direction 39° relative to the homer beacon			
12:58:12	infront of the tower sulfid mounds			
13:03:13	foto stop at southern tower			
13:04:35	southern tower is located at 39m and 14° relative to the homer beacon			
13:10:24	laser on for scaling			
13:22:25	reached the peak of southern tower			
13:26:07	end of foto stop			
13:26:29	flying southwards to the small smoker, passing the tower on the eastside, enter the valley with the small smoker			
13:28:21	foto stop at the small smoker			
13:30:25	big black plume			
13:32:47	temperatur rises up to 2,8 degree			
13:35:38	closed to the tower smoker dust is going from SE-NW			
13:41:52	shrimps at northwest side of the tower			
13:49:31	flying eastwards to M1			
13:53:36	M1 marker is smelting, temperature rises over 3, 1 °			
13:54:51	thruster dust			
13:55:10	ROV is located 18m and 1,96° relative to M1			
14:03:59	ROV is located 29 m and 340° relative to the beacon, waterdepth 2981m - calculation: M1 is located at 45 m due 354° relative to beacon			
14:05:46	flying northwards to M2			
14:08:42	reached the smoker who looks like a fork			
14:10:11	reached the westside of the cliff near by M2, waterdepth 2987m			
14:11:12	flying to the north around the cliff			
14:15:58	reached the "Stalagmite", a lot of dust			
14:16:42	flying to the west, than change direction and want to fly to M2			
14:17:51	"Stalagmite", waterdepth 2982 m, 14m northwards relative to the beacon			
14:23:53	hydrothermal sediments			
14:26:18	infront of the tower sulfid mounds			
14:28:09	shrimps and one vent crab at the southwest side of the smoker by M2			
14:29:00	starting biosampling			
14:37:43	trying to catch shrimps with the net			
14:38:44	brown ceab sitting on the chimney wall			
14:39:55	caught a huge crab	130ROV-1	crab, shrimps	
14:44:18	trying to catch shrimps with 2nd net			
14:46:41	caught 4 shrimps			
14:54:01	all shrimps are gone			
14:57:20	caught 2 shrimps with little piece of altered rock	130ROV-2	shrimps, rock	

Meteor M64/1 ROV-Protokolle

Station No:	<b>130 ROV</b>	<b>ME-64/1</b>	Call RC
Segment (area):	4°48.6'S/12°22.4'W, Target: Wideawake Tower (fotoshooting, sampling, marker, fluids)		
Date: 13. April 05	<b>Dive 40</b>		
Time (hh:mm:ss)	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE
15:01:36	trying to grab an altered rock sample - failed		
15:09:03	flying westwards over the plateau, trying to get mussels		
15:13:21	lineated in combination with jumbled lava flows, mussle patches		
15:15:33	biosampling failed, only schill, some snails and vent crab, very scattered		
15:17:39	flying back to the smoker M2		
15:20:20	thruster dust		
15:21:55	arriving at M2 hydrothermal site		
15:25:41	deployment of the Harald Straus Münsteraner smoke catching device at M2		
15:32:28	Particle catcher on the way		
15:34:11	catcher deployed into the smoker	130ROV-3	catcher with t
15:35:03	catcher is grey		
15:37:08	catcher placed in sample box (middle of upper row)		
15:45:17	deployment of the high temperature logger of Sven Petersen/Oktopus		
15:47:51	approaching the smoker with the temperature logger		
15:53:51	trying to bring the T-logger back to drawer		
15:56:00	serious problems with the ROV		
16:05:41	ROV at 2968m - 21m above ground		
16:20:48	ROV is coming up		

Meteor M64/1 ROV-Protokolle

Station No:	141 ROV	ME-64/1	Call ROV at Tel# 528	
Segment (area)	4°48.6'S/12°22.4'W, Target: Turtle Pits (fotoshooting, fluid sampling, collecting homer)			
	Date: 15. April 05			
	Notes (use "<ctrl>t" to add date and time!)			
		CODE	SAMPLE	MARKER
8:36:56	Begin of station at 4°48.652'S 12°22.43'W			
10:52:12	bottom view at 4°48.573S 12°22.400W (Gaps)			
10:58:49	homer appears on jumbled flows			
10:59:26	starting to place marker M3 next to homer; Position: 4°48.560'S 12°22.423W			
11:06:18	marker M3 placed next to the homer; checking orientation of pinocchio and stalagmite inactive chimneys looking with the ROV from behind the beacon: Beacon, pinocchio and stalagmite align at ~220° confirming the previous measurements			
11:15:15	mussle shells and beds			
11:19:16	lost bottom view - smoke			
11:20:17	mussle patch			
11:22:53	southern tower appears			
11:23:33	just smoke			
11:24:25	marker M1 appears			
11:25:47	recording exact position of marker M1			
11:27:04	vent side from the former fluid sampling appears			
11:29:43	surrounding the vent side and marker M1			
11:32:00	marker M1 is located 47m away from homer in 330° direction			
11:34:44	photo stop			
11:55:49	photo mosaik			
12:06:09	going E mapping the east side of the wall			
12:10:26	moving around for orientation			
12:13:02	locating the eastern scarp: 56m in 350° direction from homer; at 10 m to the East of M1 marker			
12:16:12	approaching southern tower			
12:18:40	photo stitching			
12:41:39	start flying to marker M2 in northern direction (330°)			
12:44:20	approaching M2 marker			
12:47:47	hitting chimney at M2			
12:52:36	starting with photo stitching			
12:56:49	chimney at M2 is boiling			
13:04:30	flying above the chimney to fill a Niskin bottle in the black smoker plume			
13:07:55	Niskin bottle 1 filled			
13:14:13	141ROV-1	Niskin 1		
13:18:03	black smoke and boiling water discharging			
13:18:47	vent crab sitting on chimney			
13:24:46	prepare for fluid sampling			
13:33:52	pump switched on			
13:38:01	pump switched off and back on; <b>note:</b> black shimmering smoke is discharging from the exhaust when the pump is on			
13:41:32	jaw opened and fluid sampling tool fell to the ground.			
13:52:35	rescue operations on-going			
13:54:15	tool back in starting position; another try to get the fluid sampling going			
13:55:02	FL takes a walk...			
13:57:38	tool in orion jaw sampling operations resume			
13:58:07	tool falls out of the jaws again!			
14:00:10	FL back on deck			
14:00:43	two fishes			
14:03:58	pump switched on; shimmering water leaves the exhausts			
14:14:36	switching the pump on and off results in a short outbreak on the exhaust			
14:19:31	pump switched off, since ROV drifted out off the plume area			
14:28:05	pump switched on			
14:33:12	snorkel stable in smoker			
14:37:21	still stable in smoker, pumps switched off and on			
14:38:08	pumps off and on. Gives black smoke at exhaust when pumps are switched on			
14:39:21	lost contact to smoker, pumps off			
14:43:10	back in smoker,			
14:43:59	pumps on			
14:44:42	lost contact to smoker			
14:45:14	back in smoker,			
14:46:14	lost contact			
14:46:52	pumps off			
14:48:30	back in smoker,			
14:49:04	pumps on			
14:50:59	pumps off, lost contact			
14:54:46	pumps on, in smoker			
15:06:14	no smoke from exhaust pipe			
15:08:48	lost contact, pumps off, end of fluid sampling			
15:09:22	141ROV-2	Fluid sample system		
15:09:49	sediment pieces falling from snorkel, possibly blocked			

Meteor M64/1 ROV-Protokolle

Station No:	141 ROV	ME-64/1	Call ROV at Tel# 528	
Segment (area):	4°48.6'S/12°22.4'W, Target: Turtle Pits (fotoshooting, fluid sampling, collecting homer)			
	Date: 15. April 05			
	Notes (use "<ctrl>t" to add date and time!)			
		CODE	SAMPLE	MARKER
15:14:24	a fish swimming from right to left			
15:16:46	positioning of M1 with compass, 40 m at 335°			
15:29:55	going west			
15:30:09	going north			
15:33:02	looking for snails close to the beacon			
15:38:49	jumbled flow with shells			
15:42:36	flying westward to M2			
15:47:50	approaching M2 marker			
15:57:21	18° 28m to homer			
16:03:54	flying into the smoke above the chimney			
16:04:36	Niskin bottle 2 (middle) filled	141ROV-3	Niskin 2	
16:07:43	Niskin 3 (links) filled	141ROV-4	Niskin 3	
16:14:17	Position M2 : 17°, 24 m			
16:16:22	S Tower 17°, 37 m			
16:22:08	back to M2			
16:30:35	Preparing to use particle catcher at M2			
16:35:24	deployment of particle catcher			
16:42:23	particle catching successful; placed in middle bin, lower row	141ROV-5	Particle catcher	
16:52:21	this picture shows the site of the GTV location 139; on the western foot of the M2 marker site			
16:58:30	Bythilide Fish			
17:00:42	ROV going to the south			
17:04:25	Positioning of M1 site: 350° 53m: ROV located to the south of the smoker, ROV, Smoker and M1 marker aligned			
17:08:49	eastern wall of the pit at the position: 346° 50m relative to the beacon; wall is oriented N-S (360°); depth of valley is about 4 m			
17:13:20	wall turns slightly to the NW aproaching the M2 site			
17:16:03	fish			
17:16:10	beacon site; the eastern and western valley walls are 5 m apart			
17:23:39	orion has recovered the beacon			
17:30:12	beacon in sampling box			
17:34:13	ROV leaves seafloor starting ascent			
19:36:49	ROV reaches surface			
19:49:13	ROV on deck	141ROV-6	sulfide samples on ROV tray	



Meteor M64/1 ROV-Protokolle

Station No:	146 ROV Dive 42	ME-64/1		
Segment (area):	4°48.9'S/12°22.4'W, Target: exploration in rift valley to the west of Turtle Pits and transit to Red Lion + fluid sampling; Smokers at RED LION: "Shrimps-Smoker", "Sugar-Head", "Mephisto", "Tannenbaum"			
	Date: 16. April 05			
Time	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	
9:59:25	ship at at 4°48.89'S 12°22.44'W, HS depth: 3000m; ROV at 320 m depth			
10:00:00	switch on kips-pump			
10:07:48	depth ROV 520m, ship at 4°48.90 S 12°22.41 W			
10:27:14	ROV at 1000m; ship at 4°48.91S; 12°22.40 W			
10:45:40	switch off kips-pump			
10:48:02	ROV at 1503m; ship at 4°48.90S; 12°22.40 W			
11:09:07	ROV at 2000m; ship at 4°48.90S; 12°22.39 W			
11:30:48	ROV at 2500m; ship at 4°48.91S; 12°22.39 W			
11:49:43	Atimeter 35 m			
11:51:04	seafloor in sight Rov at 2990m, Ship at 4°48,88S; 12°2.39W, HS 2996m			
11:52:30	diving up 10m heading 288°			
11:53:41	Ropy lava, less sedimented			
11:55:11	still heading 270° 2990m			
11:56:52	still standing for oriantation, problems with GAPS, go 20m W 2991m			
11:59:59	lava changed from ropy to jumbled, increasing sediment			
12:02:30	still heading W			
12:05:34	flying 20m to the west			
12:06:10	fluid sampling system			
12:06:47	ropy lava slightly covered with sediment			
12:09:16	80% sediment cover			
12:10:59	perfect whorls structures			
12:13:59	80% sediment cover			
12:16:54	ropy surface covered with sediment			
12:18:31	flying 700m to the west			
12:19:06	ropy lava with thin sediment cover			
12:20:41	lobate flows and pillow lava			
12:21:28	lobate flows - sediment in pockets			
12:21:39	flying up the flanks of a little volcano			
12:22:34	50% sediment cover			
12:24:49	lobate flows - sediment in pockets			
12:25:44	Holothuridae			
12:27:10	pillow lava slightly covered with sediment			
12:29:50	little NE-SW orientated fissure in the pillow lava flow on the flanks of the volcano			
12:34:40	trough - probably 3m deep - still heading west			
12:35:03	pillow lava and lobate flows slightly covered with sediment			
12:35:43	sediment cover increases - ca. 40%			
12:38:37	very rough surface 2m up and down			
12:39:52	flying down still along the eastern flank of the volcano			
12:41:22	ropy lava surface with thin sediment cover			
12:42:44	fish			
12:43:24	jumbled like structures (Jens)			
12:46:02	flying still 5m above the seafloor, heading W			
12:47:08	sediment decreases 3010m			
12:48:16	ropy lava			
12:48:55	fish eellike			
12:49:24	sediment increasing			
12:51:10	changing from lineated to ropy again			
12:55:58	lobate flows			
12:56:36	flying 20m down			
12:57:32	lobate flows and pillow lava			
12:58:58	flying down the western flank of the volcano - lobate flows and pillow lavas			
13:00:41	little NE-SW orientated fissure in the pillow lava flow on the flanks of the volcano			
13:01:14	single pillows sticking out of the sediment (60%)			
13:02:55	Holothuridae			
13:08:25	pillow lava on a gentle slope of the eastern flank - thin sediment cover			
13:11:39	shrimp			
13:13:18	flying up a 22m cliff composed of pillow lavas			
13:13:44	pillow lava field			
13:17:29	lobate flows - sediment in pockets			
13:23:52	flying to the western flank of the volcano, where we found high Neph (volts) mapper signals			
13:26:36	pillow lavas and lobate flows - sediment in pockets			
13:29:22	pillow lavas and lobate flows - sediment in pockets			
13:31:24	fish Ophidiformes			
13:34:35	lobate flows			
13:43:12	same spot as before, not moving, nice, but older lobate to pillow flow			
13:47:10	start moving again, heading north, depth 2982m			
13:49:38	large pillows, sediment stained, gorgonarie, grey=not glassy			
13:52:34	searching in the vivinity for sampling point for pillows			
13:53:18	on top of local high, depth=2976m, beautiful pillows			
13:54:59	fissure running N-S, ~ 1-2 m wide, trying to sample these pillows			
14:00:25	not clear where to sample, no easy spot, pillows too large			
14:02:56	slowly mowing to the north along fissure, more sediment between pillows			

Meteor M64/1 ROV-Protokolle

Station No:	146 ROV Dive 42	ME-64/1		
Segment (area):	4°48.9'S/12°22.4'W, Target: exploration in rift valley to the west of Turtle Pits and transit to Red Lion + fluid sampling; Smokers at RED LION: "Shrimps-Smoker", "Sugar-Head", "Mephisto", "Tannenbaum"			
	Date: 16. April 05			
Time	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	
14:04:47	Schlangensterne (Ophiuroidea) and sea stars (Asteroidea, Brisingidae) sitting next to "cauliflower"			
14:08:35	taken rock sample, placed into lower right box (4°48.883'S / 12°22.930'W), depth 2973m the sample belongs to the grey, slightly sedimented pillow and lobate flows in the area	146ROV-1		pillow basalt
14:14:38	moving 30 m west, then 30 m to north			
14:16:48	crossing the same fissure we saw before while heading west			
14:18:46	sedimented pillows and lobate flows, sediment 80%			
14:23:01	flying to N, sedimented pillows			
14:24:49	turning to E going 30m ahead			
14:26:39	sedimented pillows and lobate flows, sediment 80%			
14:27:33	approaching same fissure from the western side			
14:34:46	flying over sedimented pillows, turning to north			
14:38:46	pillows, less than 20% sediment, flying 32°			
14:39:19	increasing sediment, same old flows, fish			
14:42:05	still pillow mound, depth 2988m			
14:47:44	pillows sticking out of sediment			
14:50:14	fissure running N-S, ~ 1-2 m wide			
14:52:14	flying down the western flank of the volcano - sedimented lobate flows and pillow lavas			
14:54:24	fish			
14:56:52	sediment cover increases - ca. 40%			
14:59:46	rough surface - troughs and hills made up of pillow lava			
15:05:14	claft partly filled with sediment			
15:08:14	pillows and lobate flows with thin sediment cover			
15:09:10	flat blocky lava mixed with pillow lava, crinoid like starfish			
15:10:19	pillow lavas and lobate flows - sediment in pockets			
15:13:24	pillow lavas and lobate flows - sediment in pockets 3005m			
15:16:48	little fissure (N-S) within compact pillow lava, sediment 80%, Flying still N			
15:18:54	lobated lava less sediment			
15:19:22	following fissure again			
15:19:52	cliff on the right side, 2999m, very deep cleft, altimeter out of range (at least more than 30 m)			
15:21:56	after diving a little bit sinking again			
15:26:34	fresh lava flow with collapse structures appears, unfortunately no sampling possible, because ship is moving			
15:28:40	pillow lava and lobate flows slightly covered with sediment			
15:30:19	sediment cover increases - ca. 30%			
15:31:31	lobate flows fresh appearance			
15:37:59	lineated flows next to jumbled sheet flows			
15:41:03	jumbled flows			
15:42:42	suddenly black screen; high voltage failure			
17:30:13	ROV cameras on in 2885m			
17:50:03	seafloor in sight			
17:52:00	ropy flows with thin sediment cover (whorl)			
18:24:45	taken rock sample, placed into front left box (4°48.354'S / 12°22.693'W), depth 3024m sample obtained from ropy flows, glassy basalt	146ROV-2		ropy basalt
18:37:03	start moving north 30°			
18:38:24	jumbled flows			
18:40:14	ropy flows			
18:41:18	jumbled flows over older sheet flows with thin sediment cover			
18:44:00	jumbled flows with thin sediment cover			
18:45:04	holothurie			
18:47:33	decreasing sediment			
18:49:10	sediment covered old sheet flow below jumbled not sedimented basalt			
18:52:56	lobate lava with sediment and younger jumbled flows			
18:58:22	sheet flow with thin sediment cover			
18:59:45	lobate lava with thin sediment, collapse structures			
19:04:15	jumbled lava			
19:04:33	lobate lava with thin sediment cover			
19:08:29	pillows with thin sediment			
19:09:21	lobate lava and pillows			
19:10:49	pillows			
19:12:02	moving 0°			
19:12:59	jumbled flows at 3028m with thin sediment			
19:15:34	old lobate lava with thin sediment cover and younger sheet flows			
19:17:00	pillows			
19:18:13	enhanced distance from bottom, no clear visibility			
19:21:21	old lobate and younger sheet flows			
19:22:46	enhanced distance from bottom, no clear visibility			
19:23:53	lobate flows with very thin sediment cover			
19:28:28	three open Niskins			
19:28:51	enhanced distance from bottom, no clear visibility			
19:29:32	lobate flows with thin sediment and younger ropy flows			
19:32:59	lobate lava with thin sediment cover			
19:38:25	lobate lava			
19:39:01	pillows rarely sediment			

Meteor M64/1 ROV-Protokolle

Station No:	146 ROV Dive 42	ME-64/1		
Segment (area):	4°48.9'S/12°22.4'W, Target: exploration in rift valley to the west of Turtle Pits and transit to Red Lion + fluid sampling; Smokers at RED LION: "Shrimps-Smoker", "Sugar-Head", "Mephisto", "Tannenbaum"			
	Date: 16. April 05			
Time	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	
19:45:17	sheet lava with rounded sediment patches			
19:46:23	orange staining rocks - old chimney? In 3047m			
19:47:18	Gorgonaria			
19:56:54	trying to grab a sample from the orange staining rock			
20:12:03	seastar			
20:14:19	mussle bed (50-60 species)			
20:15:57	flying around the old chimney			
20:24:01	altered sulfide from the chimney structure sampled, 4°47.902S; 12°22.618W; 3045m	146ROV-3	sulides of inactive chi	
20:27:14	flying 100m towards north			
20:29:49	collapse structure, pillow lava flow			
20:31:33	jumbled flows, grey with rare sediment cover			
20:32:22	jumbled to tortured flow breccia, heading 020			
20:32:50	fish, alone in the jumbled breccia			
20:34:03	gorgonaria in jumbled flow breccia, slowly going downhill depth: 3056m			
20:35:04	jumbled flow breccia, <b>more intense particles</b> in the water column?			
20:37:27	fish over sheet flow with sediment "dunes"			
20:38:33	thrusterdust, over sheet flow with "dunes"			
20:40:58	sheet flow with "dunes"			
20:41:40	holothurie sitting on one of the sand dunes			
20:42:33	small pressure ridges between flat areas of shett flows with "dunes", depth 3059m			
20:44:06	stopped, looking around for Red Lion			
20:44:50	fish over jumbled flows, heading sothest (110)			
20:47:03	will try to look around with sonar			
20:57:27	moving SE again over jumbled flows			
20:59:31	turned to south			
21:00:47	stopped, turned to west			
21:08:09	turning to 135°, going ahead			
21:09:17	flying to the given position nearby Red Lion, 3055m			
21:10:03	pillows less sedimented			
21:11:39	stopped turing W			
21:12:49	jumbled lava, sheets			
21:13:42	turning N going slope down			
21:14:37	turning to E looking ahead, moving E, increasing particle flow			
21:15:58	ropy sheets, flow front (?) changed to pillows			
21:19:08	flying S pillows sedimented			
21:21:05	turning W flying ahead, pillows			
21:23:23	haeding N, flying above ropy lava			
21:25:15	lava jumbled shifting to pillow			
21:26:18	turning to E over W and S, moving E above ropy lava to pillows			
21:28:26	lobate lava more sediment			
21:29:18	sediment increasing, 3055m			
21:31:21	turning S, looking again on pillows, less sediment			
21:32:44	shrimps; nearly 20			
21:36:45	shrimps number increase			
21:39:36	smoke appears			
21:40:07	flanges covered completely with shrimps, wide (6m in diameter) chimney mound structure - Red Lion?			
21:46:20	facing south several little chimneys appear			
21:47:16	shimmering water			
21:48:38	ROV is circling the structure			
21:49:54	black smoke coming out of a fissure			
21:52:51	smoke drifting from north to south			
21:54:07	several inactive chimneys at the flanks			
21:55:42	the structure is about 3m high			
22:02:17	trying to catch shrimps			
22:31:00	shrimp sampling (unsuccessfull)	146ROV -4	shrimps I	
22:32:13	Niskin 3 closed (mistake)	146ROV-5	Niskin 3	
22:35:35	the net is damaged -> new net will be deployed			
22:48:13	catching shrimps - net full of shrimps	146ROV -6	shrimps II	
22:48:41	very successful shrimp catching			
22:57:35	peace of the chimney "shrimp smoker" sampled; 4°47,824S; 12°22,595W; 3048m	146ROV-7	sulfide	
23:06:08	flying to the north - pillow lava field			
23:08:10	orange sediment inbetween the pillows			
23:08:27	orange sediment coverage increases			
23:09:03	single chimney structure appears			
23:10:08	chimney with white top (shrimps) is smoking quite heavily			
23:11:40	behind that white top chimney another acitve chimney appears - looks like a devil (mephisto - approx. 5m high): GAPS: 4°47,824S, 12°22, 595W; 3056m - structure is 4m high, 8m in diameter			
23:17:07	in southern direction? (propably compass not working!) another chimney appears - approx. 6m high and 1m in diameter - small smoke plume - GAPS: 4°47,832S; 12°22,600W			
23:36:05	flying to north-west: pillow lava flows			
23:41:12	flying back tp to south-east			
23:42:57	ROV hit the ground - going up 8m			

Meteor M64/1 ROV-Protokolle

Station No:	146 ROV Dive 42	ME-64/1		
Segment (area):	4°48.9'S/12°22.4'W, Target: exploration in rift valley to the west of Turtle Pits and transit to Red Lion + fluid sampling; Smokers at RED LION: "Shrimps-Smoker", "Sugar-Head", "Mephisto", "Tannenbaum"			
	Date: 16. April 05			
Time	Notes (use "<ctrl>" to add date and time!)		CODE	SAMPLE
23:44:27	shrimps on bottom, sedimented pillows, hydrothermal sediments yellow-brownish colour			
23:46:19	heading S, going ahead			
23:47:27	smoker ahead "Tannenbaum"			
23:54:00	flying 245° to "shrimp smoker" (struture with flanges, first hit)			
23:58:34	looking to W on the "Shrimps Field", pillows, flying over it			
0:00:27	stopped at the field's end, going ahead further W			
0:01:29	pillows again			
0:01:51	Tannenbaum and the Shrimp-Smoker located for positioning, searching for "Mephisto" and the other structure			
0:04:17	flying W over the shrimp field			
0:04:57	looking S, stopped at the end of the field			
0:05:52	"Shrimps-Smoker" in sight			
0:08:16	flying W			
0:08:46	pillows uncoverd by shrimps, going W			
0:09:38	slope ahead, ROV stopped			
0:10:34	turning to 133°, flying			
0:11:14	crossing mussel shill (?)			
0:12:00	second Smoker ="Sugar-Head"			
0:15:12	"Shrimps-Smoker": 4°47,810S, 12°22,605W; "Tannenbaum": 4°47,806S, 12°22,602W, distance 12m at 250° from "Shrimps-Smoker" to Tannenbaum", "Sugar Head": 4°47,818S, 12°22,607W, and 16m at 09° from Sugar-Head to Shrimps-Smoker			
0:25:16	Octopus at NE side of "Mephisto"			
0:34:02	Octopus swimming			
0:35:04	Octopus sits again			
0:36:36	going back to "Mephisto" closing Niskin, second Niskin will be closed at "Sugar-Head"			
0:46:57	closing Niskin 1 at "Mephisto" 3045m	146ROV-8		Niskin 1
0:48:34	going to "Sugar-Head" for closing the last Niskin			
1:03:54	niskin 1 is not closed, error in closing mechanism			
1:10:21	closing Niskin 2 at "Sugar-Head", 3047m	146ROV-9		Niskin 2
1:20:41	starting to ascend to 2850 m, testing fluid sampler device			
1:23:52	reaching 3000 m			
1:26:30	reaching 2950 m			
1:28:09	at 2910 m, motor of fluid sampler turns again			
1:36:51	all valves working, function move it activated, diving down to 3000 m			
1:41:56	at 2950 m, all systems still working			
1:44:43	at 2988 m, all systems still working			
1:45:37	at 3000 m, all systems working			
1:47:50	at 3020 m, all systems working			
1:51:08	3043.8 m, 4.0 m above ground, all systems working			
1:52:19	move it button de-activated, reset function ok, approaching smoker for fluid sampling !!!			
2:02:59	preparing for fluid sampling at Mephisto chimney			
2:09:30	handle out of holder			
2:13:53	compass out			
2:15:30	depth: 3041.6 + 4.7 m, approaching Mephisto with sampling nozzle			
2:17:19	pump on, filling sample 1, discharge site in top of chimney, torque at 45 Nm	146ROV-10		fluid from Mephisto
2:23:24	move to sample bottle 2, bottle open, pumping	146ROV-11		fluid from Mephisto
2:26:44	black smoke coming out of exhaust			
2:27:28	move to sample bottle 3, bottle open, pumping	146ROV-12		fluid from Mephisto
2:32:24	nothing discharging from exhaust but hopefully ...			
2:33:36	move to sample bottle 4, bottle open, pumping	146ROV-13		fluid from Mephisto
2:39:00	move to sample bottle 5, bottle open, pumping	146ROV-14		fluid from Mephisto
2:43:20	pumping stable at 1,2 Ampere			
2:43:54	pump out, reset, move to port 16, pump on, pumping at 1,1 Ampere, filter 1+2 for biology	146ROV-15		fluid from Mephisto fo
2:47:48	pumping stable between 1,1 and 1,3 Ampere			
2:49:53	close valve 16, pump off			
2:52:08	no large particles out of nozzle			
2:53:00	moving to Sugarhead for next fluid sampling			
2:56:31	pump on to clean, pumping into sampling port 6			
3:01:03	pump closed			
3:04:38	arriving at Sugarhead			
3:17:00	pump on, valve 6 open, pumping fluid	146ROV-16		fluid from Sugarhead
3:23:09	<b>NOTE: all four smokers are not as hot, no gas bubbles discharging</b>			
3:23:54	move to port 7, not working, pump out, reset, ok, pump on			
3:24:47	start pumping into bottle 7 from same vent	146ROV-17		fluid from Sugarhead
3:29:54	move to port 8, not working, pump out, reset, ok, pump on			
3:30:45	start pumping into bottle 8 from same vent	146ROV-18		fluid from Sugarhead
3:35:49	move to port 9, not working, pump out, reset, ok, pump on			
3:36:39	start pumping into bottle 9 from same vent	146ROV-19		fluid from Sugarhead
3:42:18	move to port 10, not working, pump out, reset, ok, pump on			
3:43:00	start pumping into bottle 10 from same vent	146ROV-20		fluid from Sugarhead
3:48:07	move to port 17, pump out, reset, ok, pump on			
3:48:59	start pumping from same vent through port 17, filter 3+4 for biology, pumping at 1,3 Ampere	146ROV-21		fluid from Sugarhead
3:54:16	pumping at 1,3 Ampere, pump out, moving to Tannenbaum			
3:57:23	turn pump on for cleaning for 5 minutes, valve 11 open			

Meteor M64/1 ROV-Protokolle

Station No:	<b>146 ROV Dive 42</b>	<b>ME-64/1</b>		
Segment (area):	4°48.9'S/12°22.4'W, Target: exploration in rift valley to the west of Turtle Pits and transit to Red Lion + fluid sampling; Smokers at RED LION: "Shrimps-Smoker", "Sugar-Head", "Mephisto", "Tannenbaum"			
	Date: 16. April 05			
Time	Notes (use "<ctrl>t" to add date and time!)	CODE	SAMPLE	
3:58:48	approaching Tannenbaum			
4:04:15	Tannenbaum: 3041.4 + 4.5 m			
4:08:34	"conditioning nozzle", then move to chimney again			
4:10:30	Orion handle opened and lost nozzle, starting to recover			
4:23:18	dark sreen, cameras out !!!			
6:11:50	cameras work again, ROV at 2876.5 m			
6:15:03	<b>End of Dive, ROV is coming up</b>			
9:14:08	ROV on deck			

Meteor M64/1 ROV-Protokolle

Station No:	<b>155 ROV Dive 43</b>	<b>ME-64/1</b>		
Segment (area):	8°50'S volcanic area; target: exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m), starting from old lavas in the west towards the east			
	Date: 19. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
8:21:13	ROV in the water; ship at: 8°48,99'S 13°30,48'S; water depth 2611 m			
8:30:00	ROV at 200m going down (8°48,99'S 13°30,48'S)			
9:24:49	ROV at 1412 m			
9:54:52	ROV at 2000 m			
10:02:35	bottom in sight, sedimented sheet flows, depth 2167m, trying to get GAPS fix			
10:08:30	at same position, fish is visiting			
10:13:24	turning to east, rough morphology, jumbled flows, volcanoclastics on top of sediment			
10:15:05	fault scarp with 13 m offset, will try sampling of the upper part of this scarp			
	fault is oriented N/S and west facing, positioning to take sample			
10:21:25	sampling of autobrecciated "in situ" lava, sedimented			
10:23:21	thrusterdust, first attempt failed, try again			
10:26:03	thrusterdust, second attempt failed, try again			
10:28:02	third try at scarp itself, thrusterdust			
10:30:40	will try to use bionet for rock sampling (sorry biologists!!)			
10:35:24	sampling with bionet succesfull, several kg; position: <b>8°48,98'S / 13°30,50'S</b> , depth: 2161m	155ROV-1	basalt	
10:40:21	sample stored in large box			
10:44:26	turning to east, will start traversing, here we are western edge of flows in faulted terrain			
10:48:38	poor visibility due to our sampling attempt, getting deeper			
10:52:57	small east-facing terraces, flying high to avoid to stir up sediment			
10:56:09	coming down on talus field, depth 2186m, angular pieces of basalt, some tube relics			
10:57:20	facing west facing wall of pillows, ~ 25 m high			
11:01:13	in front of west facing talus pile; depth 2170m			
11:03:15	will try to sample this pillow talus, less sediment, but probably because of currents			
11:07:53	sampling of large block within the talus field; position: <b>8°48,99'S / 13°30,44'S</b> , depth: 2172m	155ROV-2	basalt	
11:09:38	sample stored in box 1			
	the basalt seems to be overgrown by fauna (actinie?)			
11:15:50	flash is not working			
11:17:42	moving again, heading east over well sorted talus, coming up, depth 2165m			
11:19:05	gorgonarie, top of this mound in 2158m			
11:22:04	pillow lava and lobes, depth 2176, hdg:117			
11:23:58	only slightly sedimented pillows and lobes, depth 2180m, mound ahead			
11:25:36	climbing up pillow basalt mound, depth 2170m, flying high			
11:26:45	nice pillows and tubes, depth 2160m			
11:29:27	sedimented ropy flows, depth 2150m; hdg: 110			
11:31:15	collapse structure in sedimented ropy flows			
11:39:16	heading 110°, above ropy flows; 2155 m, surching for sampling station			
11:47:22	going 110°			
11:50:37	try to sample old basalt with Orion, lobate lava, sediments 75%			
11:51:37	thruster dust			
11:54:36	taking sample; <b>08°49,00'S / 13°30,30'W</b> ; depth: 2149m	155ROV-3	basalt	
11:58:29	going E			
11:59:36	pillows and lobate lava, strongly sedimented, stopped to look at			
12:01:00	going on E			
12:02:13	lobate lava , strongly sedimented			
12:11:33	lobate to pillows, hdg. east			
12:18:28	lobate to ropy flows, thin sediment cover, depth 2177m			
12:21:48	pillows to lobate and tubes, thin sediment cover, depth 2188m			
12:25:45	same position, waiting for something?			
12:27:16	start to sample basalt with orion, heading 104°, 2191m, exposed basalt with sponges			
12:32:42	thruster dust			
12:37:03	looking for sampling spot in beautiful sedimented pillows, striated pillows			
12:42:24	first attempt failed, looking for better spot			
12:45:49	still looking for the spot, no easy place to grab!! Thrusterdust			
12:50:12	second attempt failed, looking for better spot			
12:54:41	and another try :-( ... and another ...			
13:01:42	holothurie (pink) at sampling point			
13:03:07	and another try :-( ... and another ...			
13:07:55	this time we settle for a place with a gorgonarie			
13:08:54	thrusterdust			
13:16:50	and another try :-( ... and another ...			
13:16:51	small fracture in pillowed terrain			
13:20:25	FINALLY! taking sample in pillows near fracture; <b>08°48,96'S / 13°30,17'W</b> ; depth: 2195m	155ROV-4	pillow basalt rim	
13:25:36	turning east again			
13:27:01	pillow field, thin sediment cover			
13:33:35	flying east over small pillows; few larger pillows (older generation) in between?			
13:34:32	a younger flow of small-sized pillows seems to come in from the south			
13:37:34	lonely fish in the dark pillows			

Meteor M64/1 ROV-Protokolle

Station No:	155 ROV Dive 43	ME-64/1		
Segment (area):	8°50'S volcanic area; target: exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m), starting from old lavas in the west towards the east			
	Date: 19. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
13:38:32	sedimented pillows			
13:39:29	increasing lobate content, very flat terrain, continous at 2197m			
13:41:42	flows come from the east, several flows on top of each other, pancake			
13:45:12	same flows, slightly sedimented			
13:46:41	more pancake flows, less pillows, sediment cover is increasing			
13:49:07	small ridge, fracture facing east (1m), contact to large talus field			
13:52:09	fracture facing east (1m), contact to large talus field			
13:53:58	fracture facing east (1m), contact to large talus field with sediment patches			
13:55:51	try to sample basalt talus			
14:00:59	sampling successful: <b>8°48,99S, 13°30,06W</b> ; 2199m	155ROV-5	pillow basalt fragment	
14:06:21	flying to the east, 2 Gorgonarie			
14:06:37	collapse structure in sedimented ropy flows			
14:07:01	lava flow front horizontally laminated			
14:07:43	lobate flows			
14:09:16	pillows to lobate and tubes, thin sediment cover, depth 2188m			
14:09:48	Gorgonarie			
14:12:27	trying to grap another pilow fragment			
14:18:50	ROV hit the ground			
14:19:12	thruster dust			
14:21:28	try to sample basalt from pillow lava			
14:32:55	sampling successful: <b>8°48,99S, 13°30,04W</b> ; 2190m	155ROV-6	pillow basalt fragment	
14:38:18	lobate flows			
14:39:14	drifting holothurian over steep escarpment, N/S trending			
14:43:34	east facing scarp, at least 20 m deep			
14:47:01	heading east, base of cliff is sedimented, going east another 30 m, depth 2209m			
14:50:55	trying to appoach seafllor but going downhill, depth 2213m			
14:53:27	flattened ground at 2214m, sedimented pillows			
14:55:05	ROV is appeoaching seafloor, depth: 2221m, small fracture			
15:00:32	need to readjust the GAPS position			
15:02:40	try to sample basalt, 2221m			
15:14:19	failed, and another ... and another ... and ...			
15:19:13	well lets go for the schovel!			
15:23:34	collected small pebbles, stored in box 5 (there was another sample in there before!)	155ROV-7	basalt pebbles taken with	
	sampling successful: <b>8°48,99S, 13°29,97W</b> ; 2221m			
15:30:51	moving 20 m to the east, pillows, sedimented			
15:33:17	pillows, sedimented, another 20 m east			
15:33:40	few large pillows			
15:35:22	large sedimented pillows			
15:38:16	stopped, sedimented pillows			
15:39:07	moving again, sedimented pillows, depth 2215m			
15:45:47	small break, now moving again, sedimented pillows			
15:46:56	at base of wall?, depth 2215m, only little talus			
15:47:42	going up to 2199m, 15 m high scarp facing west			
15:50:21	on top of narrow ridge, going down on other side			
15:53:01	flying high over the ground, nothing to see			
15:54:46	blue sky			
15:57:48	bottom view, talus field - still flying east			
15:58:34	pillow and lobate flows			
15:59:21	east facing scarp, at least 10m deep; waterdepth 2216m			
16:07:46	pillow lava and lobes, depth 2215m, 20% sediment cover			
16:14:58	fissure, N-S; 0.5 m to 1 m wide			
16:15:22	start sampling with schovel			
16:20:59	small fissure, N-S; same as the one above, trending ~135			
16:30:55	still sampling :-)			
16:31:21	schovel back into box			
16:40:46	bottom current is strong ROV needs to follow the ship			
16:40:53	moving south, sedimented pillows			
16:41:36	small pillows are overflowing older sheet flows, barely visible underneath			
16:42:45	setting ROV on the ground for sampling, depth 2218m			
16:44:03	thrusterdust			
16:48:20	trying to sample sedimented pillows			
16:51:34	still sampling :-)			
16:54:24	still sampling :-)			
16:59:23	sampled tiny chips : <b>8°49,04'S / 13°29,85'W</b> ; 2218m	155ROV-8	basalt chips?	
17:02:57	geosampling is finished; moving few m to the east before ascending			
17:06:22	a fish in the sky, start moving to east over sedimented pillows			
17:07:34	small pillows			

Meteor M64/1 ROV-Protokolle

Station No:	<b>155 ROV Dive 43</b>	<b>ME-64/1</b>		
Segment (area):	8°50'S volcanic area; target: exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m), starting from old lavas in the west towards the east			
	Date: 19. April 05			
<b>Time (hh:mm:ss)</b>	<b>Notes</b>	<b>CODE</b>	<b>SAMPLE</b>	
17:08:06	climbing up pillow basalt mound, depth 2215m, sediment on top			
17:08:41	fissured area, top of small terrasse, sediment thickness ~ 20 cm			
17:09:42	steep scarp ahead facing west			
17:12:54	fissures trend 310/130			
17:14:03	thick sediment			
17:14:32	back west over sedimented pillows			
17:15:44	same pillows heading west			
17:16:30	east-west trending fissure			
17:16:47	moving north, turning			
17:17:33	large talus field, heading northwest to METEOR, then coming up			
17:18:24	scarp, facing east, height ~15m			
17:21:39	talus field, sedimented, heading north			
17:23:04	coming up, leaving bottom			



Meteor M64/1 ROV-Protokolle

Station No:	159 ROV Dive 44	ME-64/1		
Segment (at	8°50'S volcanic area; target: south to north exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m)			
	Date: 20. April 05			
Time (hh:mm)	Notes		CODE	SAMPLE
8:32:27	ROV in the water; ship at: 8°48,09'S 13°30,09'S; water depth 2219 m			
9:29:46	ROV at 1600m			
9:50:58	bottom in sight, sedimented pillows, very similar to the those found yesterday, depth 2203m			
9:56:21	will take basalt sample, Karsten! I should have known this!			
10:01:59	compass is off, sampling			
10:04:05	first attempt failed, another try			
10:06:50	second attempt failed :-)			
10:10:51	brittle star			
10:15:32	:-) thrusterdust			
10:25:13	8°48.18'S / 13°30.12'W, depth 2204m; small bits and pieces into box 6, contamination by other bits?? from earlier dives?	159ROV-1		small pillow basalt bits
10:28:39	will now head north, compass is on, fish			
10:29:41	start moving, sedimented pillows, foto taken			
10:32:55	stopped, taking fotos			
10:33:58	testing PTFE valves for fluid pumping system, function OK			
10:36:10	start moving north again, hdg: 001, depth 2203m, sedimented pillows			
10:37:04	fish over sedimented pillows			
10:38:01	sedimented pillows			
10:39:14	sedimented pillows, sediment cover is increasing to 50%			
10:40:18	sedimented pillows and tubes			
10:41:35	sedimented pillows and tubes, fewer of the large pillows then before			
10:42:10	sediment cover thickens, lava becomes flatter, pancakes			
10:44:03	pancakes to sheets, sediment 80%			
10:48:49	taking rock sample at sheet flow			
10:51:35	first attempt failed, another try			
10:54:08	sampled small piece of sheet flow in box 4; 8°48.15'S / 13°30.12'W; depth 2201m	159ROV-2		sheet flow
11:00:07	start moving north , thrusterdust			
11:01:14	sedimented sheet flows with few tubes, sediment 70%			
11:02:39	more pillows and fractures, but generally sheets			
11:04:05	stopped, sedimented sheet flow, broken			
11:04:42	moving again, sedimented sheet flow			
11:05:40	sedimented sheet flows with few tubes, sediment 70%			
11:06:03	more pillows and lobes, less sediment 30% (younger flow or bottom currents?)			
11:07:20	sedimented pillows			
11:07:54	large flow, more sediment, pancake			
11:08:46	sedimented lobes, sediment 70%			
11:09:23	sedimented lobes, sediment 70%			
11:11:22	moving backwards			
11:12:34	heading north, sedimented lobes			
11:14:06	sedimented lobes, sediment 50%			
11:15:13	sedimented pillows and lobes, sed 50%, fish			
11:16:11	contact between lobes and pillows			
11:17:11	sedimented pillows, sed 10%			
11:17:51	sedimented pillows and tubes, sed 10%, depth 2200m, hdg: 355			
11:19:09	sedimented pillows, sed 30%			
11:20:05	sedimented pillows to sheets, sed 30%			
11:22:13	contact to jumbled flows, less sediment			
11:23:29	will take sample at flow front of jumbled flow			
11:28:08	sampled small piece of jumbled flow in large box next to shovel; 8°48.06'S / 13°30.12'W; depth 2198m	159ROV-3		jumbled flow
11:31:38	closing front drawer, parking arm			
11:32:29	start moving, jumbled flows, depth 2197m			
11:35:19	sediment slightly increasing			
11:36:12	going up on a plateau plane lava forms, 2196m sheet flow, my be lineated covered by sediments			
11:39:23	on the bottom of plateau pillows and lobated lava strongly sedimented 2199m			
11:41:35	sediment covers >75%			
11:43:41	lobate contact pillows, sediment 80%			
11:46:47	lobate contact ropy forms (wirls) with several depressions in between , some jumbled characteristics in view			
11:48:27	going to take a sample nearby a plane lava structure consisting of single plates, which were shifted upwards, covered by 100% sediment			
11:50:06	thruster dust			
11:53:35	plates contact pillows			
11:55:12	Gorgonaria, threadshaped			
12:11:21	changing tool from Orion to net, 2201m			
12:16:30	sample was taken, 8°47,99 S; 13°30,12 W sedimented sheet flows, 2201m, sample in box3	159ROV-4 (n		sheet flows

Meteor M64/1 ROV-Protokolle

Station No:	159 ROV Dive 44	ME-64/1			
Segment (at	8°50'S volcanic area; target: south to north exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m)				
	Date: 20. April 05				
Time (hh:mm)	Notes		CODE	SAMPLE	
12:21:01	looking to W				
12:22:23	large broken sheets, sed 90%				
12:23:39	moving west 20 m				
12:24:12	thick sedimented sheet flow				
12:24:54	younger pillows cover sheet flow				
12:25:33	beautiful sedimented sheets flows, broken, sed 70%, stopped				
12:27:51	start another 20 m to the west, large broken sheets				
12:28:54	edge of sheet flow				
12:29:28	sedimented ropy flows				
12:30:16	contact to jumbled flows, less sediment, gorgonarie				
12:31:04	another 20 m to the west, over jumbled flows				
12:32:20	stopped, other side of jumbled flow				
12:32:53	fractured sedimented sheets, sed 70%				
12:34:04	contact to jumbled flows, coming in from the north				
12:34:56	back in jumbled flow breccia				
12:36:34	stopped in jumbled flow breccia				
12:36:58	north/south trending cracks, turning north				
12:38:46	start moving north in jumbled flow breccia, depth 2197m				
12:40:22	at edge of flow breccia, sedimented pillows and lobes appear				
12:41:17	sedimented pillows, fissured				
12:42:05	sedimented pillows, fissured, we moved in total 40m to the north				
12:43:42	moving north, sedimented pillows to lobes				
12:44:54	at base of small wall, sedimented pillows, depth 2200m				
12:46:42	another 10 m to the north, uphill				
12:47:27	contact to pillow mound, shrimp				
12:48:29	macroide, climbing pillow mound, depth 2192m				
12:49:53	two generations of lava, older, larger pillows and smaller younger tubes				
12:50:29	still climbing, depth 2190m, waiting for ship?				
12:54:23	still climbing, depth 2184m				
12:55:50	trying to sample pillow, depth 2182m, second shrimp				
12:57:10	Viel Spass Susanne				
12:57:31	thrusterdust				
13:02:03	start to take a sample, 2986m				
13:12:56	sampling successful: <b>8°47.96'S; 13°30.16'W</b> ; 2186m waterdepth		159ROV-5	pillow	
13:17:24	flying 10m north				
13:17:46	flying 10m in 330° direction				
13:19:21	impressive pillow lava and lobate flow				
13:21:04	flying another 20m in 330° direction				
13:21:06	Gorgonarie				
13:22:39	flying 30m in 330° direction				
13:23:54	fish over sedimented pillows				
13:24:46	meduse in watercolumn				
13:25:46	sediment cover increased to 90% - dark patches				
13:30:19	flying 20m north				
13:32:06	pillow fragments forming little rigde sturcture on the sedimented area facing north				
13:36:11	Holoturie				
13:36:30	Gorgonarie				
13:37:50	flying along a gentle slope to the north				
13:41:40	pillow lava field covered with 40%				
13:42:29	sediment cover increased to 90% - dark patches				
13:44:08	flying 40m north				
13:45:23	little depression filled with talus material slightly covered with sediment				
13:47:13	red shrimp				
13:49:03	pillow lava and lobate flow				
13:50:34	branched Gorgonarie (1.20m high) still alive, probably 30-40 years old, partly dead				
13:58:54	sedimented pillows - ca. 50% sediment cover				
13:59:56	flying 20m north				
14:02:54	sediment cover increased to 80% - dark patches				
14:06:44	gentle slope - flying down, pillow and lobate flows with with thin sediment cover				
14:08:32	Holothurie				
14:10:56	Gorgonaria				
14:11:39	trying to sample pillow fragment, depth 2152m				
14:29:24	sedimented pillow, still trying to sample				
14:48:45	using bionet for sampling, Ooooops, lost the net, but retrieved				
14:53:23	sampling successful: <b>8°47.81'S; 13°30.19'W</b> ; 2151m depth, in large box		159ROV-6	pillow	
14:58:22	trying to sample unknown biota, not sucessful				

Meteor M64/1 ROV-Protokolle

Station No:	159 ROV Dive 44	ME-64/1		
Segment (at	8°50'S volcanic area; target: south to north exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m)			
	Date: 20. April 05			
Time (hh:mm)	Notes		CODE	SAMPLE
15:03:32	large pillows and tubes, slight sediment cover, stopped, hdg: 005, depth: 2151m			
15:07:16	replacing us 20 m to north			
15:08:07	sedimented pillows, sed 10%			
15:08:44	another 10 to the north in sedimented pilows, downhill: 2153m			
15:10:46	another 20 m to the north, sedimented pillows			
15:11:08	steep slope downhill, edge of mound, depth 2160			
15:14:47	sedimented pillows steep slope, turned to south to look at wall			
15:16:22	brittle star			
15:17:15	still at wall, depth 2177m			
15:18:20	talus at base visible, depth 2191m			
15:19:03	turning back to north, at base sedimented sheet flows, depth 2200m			
15:21:14	sampling point, sedimented sheet flow, broken into large, but thick blocks			
15:27:16	move a few meter to sample blocky lava			
15:34:01	still trying, :-)			
15:42:49	sampling successful: <b>8°47.75'S; 13°30.21'W</b> ; 2201m depth, in box 2		159ROV-7	pillow
15:47:00	flying 20m north			
15:48:31	jumbled sheet flow			
15:49:29	sheet flow covered with sediment			
15:50:49	jumbled sheet flow			
15:51:46	sheet flow covered with sediment			
15:59:30	flying 20m north			
15:59:55	sheet flow contact to sedimented pillow lava			
16:04:53	sedimented pillow lava			
16:08:28	broken sheet flows, sedimented pillows and lobes			
16:11:21	sedimented pillows and lobes, sed 70%			
16:12:27	sedimented pillows and lobes, sed 70%			
16:14:01	stopped on sedimented pillows			
16:16:20	flying over sedimente lobes, sed 70%			
16:17:19	sedimented sheets and lobes, sed 80%			
16:20:46	sedimented sheets and lobes, sed 80%			
16:21:52	sedimented sheets and lobes, sed 70%			
16:22:57	flying north			
16:23:53	broken sheet flows, sedimented			
16:25:26	sed 80%, sheet flows			
16:25:51	small fissure in sheet flows, sed 70%			
16:26:08	pillow field ahead, turning around			
16:27:23	back at broken flow			
16:28:15	searching for a point to sample			
16:35:49	still trying to sample, we call him "the Terminator"			
16:40:05	sampling successful: <b>8°47.7(6?)5(1?)'S / 13°30.21'W</b> ; 2202m depth, small piece in box 5		159ROV-8	sheet flow extrusion for
16:44:21	moving 010 over fissured sheet flows			
16:46:15	large collapse pit			
16:52:39	over pit taking fotos			
16:53:03	flying 20m north, sedimented sheet flows to lobes			
16:54:22	sheet flows have seen more recent tectonic movement, cracks are sediment-free			
16:56:58	broken sheet flows, fissure			
16:57:56	stopped in sedimented lobes, sed 70%			
17:00:15	following fissures to N			
17:02:19	sedimented pillows and lobes			
17:03:04	fish over sedimented pillows, less sed 20%			
17:04:48	sedimented pillows, brittle star			
17:09:11	sedimented pillows, sed 10%			
17:11:38	stopped over sedimented pillows			
17:12:47	moving north, sedimented pillows			
17:13:05	fish			
17:13:45	sampling point, sedimented pillows, small diameter			
17:15:23	thrusterdust, compass off			
17:17:44	on bottom, preparing for sampling			
17:31:45	sampling successful: <b>8°47.50'S / 13°30.21'W</b> ; 2215m depth, larger piece in box 1		159ROV-9	slightly sedimented pill
17:33:53	moving, turning north			
17:34:32	sedimented pillows, sed. 10%			
17:37:32	moving northwards			
17:38:15	jumbled sheet flow covered by sediments (20%)			
17:40:08	westwards surface change in sedimented pillows (sed 70%), photo stop			
17:42:46	flying north again			
17:43:16	changing pilots			

Meteor M64/1 ROV-Protokolle

Station No:	<b>159 ROV Dive 44</b>	<b>ME-64/1</b>			
Segment (at	8°50'S volcanic area; target: south to north exploration along rift valley center in area of proposed young lava flows and series of pillow mounds (depth ~ 2200m)				
	Date: 20. April 05				
Time (hh:m)	Notes		CODE	SAMPLE	
17:45:11	flying north				
17:45:28	sedimented pillows (sed 30%)				
17:46:30	turning to the east, back to the border jumbled flows/ pillow, trying to take a sample from there				
17:49:13	jumbled flow with fracture trending north - south				
17:51:48	fracture in jumbled flow trending west -east				
17:55:18	trying to grap a sample from jumbled sheet flow				
17:56:30	sampling successful: <b>8°47.46'S / 13°30.18'W</b> ; 2219m depth, larger piece in box 6		159ROV-10	jumbled sheet flow frag	
17:59:51	trying to grap another sample from jumbled sheet flow				
18:01:52	sampling successful: <b>8°47.46'S / 13°30.18'W</b> ; 2219m depth, placed behind push cores		159ROV-11	jumbled sheet flow frag	
18:04:54	flying north again				
18:06:08	Holothurie				
18:07:28	sedimented pillow field				
18:08:23	shrimp				
18:10:45	flying another 20m north				
18:11:54	flying another 20m north				
18:12:10	Holothurie, 2 Gorgonaria at exposed Pillow				
18:14:01	<b>8°47.41'S / 13°30.18'W</b> ; 22201m depth, waiting for METEOR				
18:18:55	moving on N, lobate lava				
18:22:37	increasing sediment, cracks				
18:24:09	Gorgonaria, threadshaped				
18:24:53	end of DIVE 44, last flight was 60m N, going up, 2219m				

Meteor M64/1 ROV-Protokolle

Station No:	188 ROV Dive 45	ME-64/1		
Segment (area):	9°40'S volcanic area; target: west to east exploration within axis area with abundant seamounts to the east of the main axis			
	Date: 23. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
10:25:18	ROV in the water; ship at: 9°42,54'S 13°04,95'W; water depth 1867 m			
10:28:40	200 m below sea level			
10:28:00	196m start testing the pump-system			
11:11:50	finished testing pump, successful, diving further down, pump switch on, bottles 1-5: each bottle for 5 minutes washed			
11:16:22	diving up			
11:17:28	reaching 150m			
11:19:03	stoped diving up at 124m, going down again			
11:22:17	200m depth			
11:34:09	reaching 500m			
11:50:50	black out at 867,3m			
11:52:14	screen on, 882m			
11:54:32	resetting computer system of ROV			
11:59:00	online again, 920m			
12:05:32	reachng 1000m			
12:20:30	black out again			
12:24:26	screen on, 1276m, diving slowly up			
12:29:19	reachig 1271m going down again			
12:40:27	reachng 1500m			
12:45:45	black out No3 1598,7m			
12:48:16	back again, 1604m			
12:48:52	black of No4			
12:55:05	online again, 1598m			
12:57:43	diving slowly up			
12:59:06	reaching 1596m, going down again			
13:05:39	altitude 30 m, going down			
13:06:07	bottom in sight, sedimented pillows, depth 1772			
13:09:12	start with rock sampling in sedimented pillows			
13:12:58	compass off			
13:15:00	sample in box 6; sample location: <b>09°42.48'S / 13°05.02'W</b> , depth:1772m	188ROV-1	angular piece of pillow basalt	
13:18:02	compass on, turning to east			
13:18:32	20 m to east, slightly sedimented pillows and lobes, sed 10% only in depressions			
13:19:43	gorgonaria, lobate flows, little sediment			
13:20:32	lobate flows			
13:21:20	gorgonaria, lobate flows, little sediment			
13:21:45	20 m to east, slightly sedimented pillows and lobes, sed <5% only in depressions			
13:22:36	red staining? on basalt			
13:24:04	20 m to east, slightly sedimented pillows and lobes, sed <5% only in depressions			
13:24:32	slightly more sediment in depressions of lobate flows			
13:25:45	sed 20% inceasing, going down, depth 1779m			
13:27:07	stopped at 1783m depth in sedimented pillows, hdg: 120			
13:30:46	start moving 120, turning east 20m to east			
13:30:57	thick sediment pile with few pillows			
13:32:43	strong ripple marks in 100% sediment, deepening to the south			
13:34:03	approach edge of pillow flow, coming off the mound			
13:36:46	crinoid			
13:38:45	looking for a spot to take push core sample			
13:40:02	compass off			
13:41:03	some lights off?			
13:43:28	taking sample P7, half full, dropped out into sampling container; <b>09°42.48'S / 13°04.99'W</b> , depth:1797m	188ROV-2		
13:48:03	20m to the east, compass on			
13:48:46	at edge of flow, pillows			
13:49:20	at same depth level, mound to the north, pillows			
13:50:50	pillows, another 10m east			
13:51:16	higher density of crinoids			
13:52:19	preparing to take sample, compass off			
13:58:33	sample in box 6 again; sample location: <b>09°42.49'S / 13°04.96'W</b> , depth:1787m	188ROV-3	grey pillow protrusion, well rounded	
14:01:21	compass on			
14:02:33	on edge of pillow mound, moving 10 m to the east, depth 1782m			
14:04:23	increasing number of "Seefedern"			
14:05:15	in pillow talus at edge of mound			
14:07:11	6 x Gorgonaria			
14:08:30	ascending eastwards on pillow talus to 1763 m			
14:15:37	increasing turbidity whilst progreesing eastwards			
14:16:18	descending to 1780 m eastwards			
14:17:47	further down over terraces to 1785 m			
14:19:55	white Porifera?? on large pillow			
14:26:14	large nubers of sessile fauna, filter feeders			
14:26:35	edge of mound, steep flank			
14:27:12	going down wall, 179m			
14:28:12	1797m			
14:28:47	1806m, sedimented pillows plus gorgonaria, still going down			
14:29:36	still going down (inside crater?), depth 1809m			

Meteor M64/1 ROV-Protokolle

Station No:	188 ROV Dive 45	ME-64/1		
Segment (area):	9°40'S volcanic area; target: west to east exploration within axis area with abundant seamounts to the east of the main axis			
	Date: 23. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
14:30:50	on talus slope, sedimented, depth: 1814m, heading east			
14:32:08	on talus slope, sedimented, depth: 1820m, heading east			
14:33:18	on bottom, depth 1820m, sedimented talus, moving backwards			
14:35:26	blue sky			
14:36:16	at bottom again, sed talus, 1827m, flank deepening to the south			
14:38:41	blue sky			
14:40:27	blue sky			
14:41:24	sedimented talus, 1830m			
14:43:39	still at talus slope, moving east			
14:46:33	single gorgonaria (no friends?)			
14:47:25	talus slope, 1844m			
14:48:55	contact between talus slope and sediment showing ripple marks			
14:49:56	on sediment, few large boulders, outbound wall ahead			
14:53:07	deepest part of the "crater": 1858m			
14:54:58	pillows and lobate flow talus material on sediment			
14:57:50	trying to grap a sample of the talus material			
15:05:02	in box 4; sample location: <b>09°42.49'S / 13°04.80'W</b> , depth:1857m	188ROV-4	pillow talus on E inner wall of crat	
15:11:44	flying up the eastern flank			
15:13:58	lobate flows - sediment patches about 40%			
15:19:40	lobate flows with some pillows - sediment patches about 30%			
15:20:32	flying about 20m south to get closer to the ship			
15:30:01	lobate flows with some pillows - sediment patches about 30%			
15:47:04	start moving again, sedimented pillows			
15:48:23	sedimented pillows, 1834m, numerous gorgonaria			
15:51:01	sedimented pillows to lobes, 60% sed, going downhill 1840m			
15:53:17	stopped at sediment-pillow contact, abundant sediment ahead, 1850m			
15:54:13	sediment with ripplemarks			
15:56:37	sediment with ripplemarks, single boulder			
15:58:41	100% sed, 1860m			
15:59:30	100% sed, 1862m			
16:00:05	contact to boulders, > 1m, talus?			
16:01:42	in sedimented pillows, sed 50%			
16:03:13	sed pillows, 1862m, sed 50%			
16:05:48	stopped in sed pillows, 1862m, sed 50%			
16:08:00	moving again, more sediment, nice pillows, sed 75%			
16:10:06	stopped again, compass was off for a few minutes			
16:10:53	heading east, increasing sediment thickness			
16:12:22	contact to boulder field, less sedimented due to currents, 1864m			
16:13:32	will try to take sample in boulder field			
16:28:37	in box 1; sample location: <b>09°42.386'S / 13°04.671'W</b> , depth:1864m	188ROV-5	pillow talus on southeastern outer wall of crater	
16:31:53	flying eastwards to a ripple field, trying to take sample with the pushcorer			
16:36:00	single gorgonaria			
16:37:11	dust from landing in the sediment			
16:37:40	start sampling with the puscorer			
16:43:13	pushcorer 8 in big box ; sample location: <b>09°42.382'S / 13°04.664'W</b> , depth:1866m	188ROV-6	sediment in pushcorer	
16:46:05	zoom to a single red gorgonaria, nearby sediment consist of pteropod schill			
16:49:34	flying eastwards			
16:49:59	single broken pillow boulder in sediment			
16:51:13	just white sediment			
16:51:30	lobate lava covered by sediment (sed 40%)			
16:52:32	single shrimps			
16:55:41	reset the GAPS			
16:57:40	flying eastwards over lobate lava with separately pillows (sed 50%), depth1867 m			
16:58:53	single gorgonaria			
17:00:34	approach edge of lobate flow, in the east is a steep slope			
17:05:35	turn to west, flying backwards (eastwards) with the quest to dive into the deep slope			
17:06:46	single gorgonaria			
17:07:31	single gorgonaria			
17:07:42	start dive into the slope, 13-15m deep, wall consist of small pillows, waterdepth 1873m			
17:11:25	out of the slope			
17:11:55	turn to south			
17:12:58	turn to east, just sediment, waterdepth 1896m			
17:14:09	small single fish			
17:14:25	sediment with changing colours (brown to white)			
17:15:02	single pillows covered by sediment (sed 75%)			
17:15:42	actinaria on pillow			
17:16:46	sediment field with current			
17:18:30	small single fish			
17:20:04	echinodermata on single pillow			
17:20:30	single small dune in sediment field			
17:22:15	lobate lava covered by sediment (sed 35%), single pillows			
17:24:22	steep slope (20%) with single lava boulders in white rippled sediment			
17:28:01	turn to north			
17:28:17	will try to take sample in boulder field			

Meteor M64/1 ROV-Protokolle

Station No:	<b>188 ROV Dive 45</b>	<b>ME-64/1</b>		
Segment (area):	9°40'S volcanic area; target: west to east exploration within axis area with abundant seamounts to the east of the main axis			
	Date: 23. April 05			
<b>Time (hh:mm:ss)</b>	<b>Notes</b>	<b>CODE</b>	<b>SAMPLE</b>	
17:35:56	frist sampling failed, rock fall down from the Quest front grid infront of the niskin bottles			
17:39:41	start second try to take sample at the same loation, waterdepth 1882 m			
17:42:29	in big box , right side; sample location: <b>09°42.36'S / 13°04.51'W</b> , depth:1882m	188ROV-7	pillow talus on S-side of the slope	
17:45:27	orion takes fluid sampling system while we're flying eastwards			
17:47:15	will try to test fluid sampling, sample bottle 6 is open			
17:51:03	flying over ripple field			
17:53:07	stop pumping			
17:56:28	moving up strongly sedimented pillow slope, checking ROV cable			
18:03:26	start pumping bottle 6 - again (1867m) - sediment 100%			
18:07:28	stop pumping bottle 6; start pumping bottle 7 (1867m) - sediment 100%			
18:13:41	stop pumping bottle 7			
18:14:41	start pumping bottle 8 (1872-1879m)			
18:18:43	gorgonaria, talus, sediment 50%			
18:19:36	stop pumping bottle 8 (1881m)			
18:19:57	deep slope; pillows			
18:22:24	gorgonaria			
18:30:21	Holoturie			
18:32:27	start pumping bottle 14; pillows and low bate (1887m)			
18:37:34	stop pumping bottle 14; Position 15 started pumping (1887m)			
18:42:33	stop pumping position 15; start pumping position 17 (Filter 3+4) (1887m)			
19:00:24	stop pumping position17 (Filter 3+4) (1885m)			
19:09:19	slightly sedimented pillows			
19:27:14	have been trying to take geology sample unsuccessfully			
19:37:17	Brinsigida (brittle star)			
19:37:50	still trying to take geology sample			
19:42:35	Aborted taking geology samples - coming up			

Meteor M64/1 ROV-Protokolle

Station No:	194 ROV Dive 46	ME-64/1		
Segment (area):	9°34'S volcanic area; target: west to east exploration within axis area, with few mounds and apparent younger lava flow			
	Date: 24. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
10:15:00	~ begin station			
11:05:57	ROV at 750m; ship at: 9°34,41'S 13°13,01'S; water depth 1482 m			
11:06:53	pumping system was tested during descend			
11:16:24	ROV at 1000m			
11:34:19	altimeter at +30			
11:34:52	bottom sight, slightly sedimented pillows, depth 1454m, ship is at 9°34.38'S / 13°13.00'W			
11:39:35	checking position and instrumentation			
11:40:12	pillows look grey and quite old, however, sediment mainly in pockets			
11:41:38	turning east, grey pillows with sediment in pockets			
11:43:48	looking for sampling site			
11:45:48	dark coarse-grained material on top of sediment, "snail" sediment? looks more like rock chips			
11:49:23	compass off for sampling			
11:52:01	fish in the background, preparing O'Ryan			
11:54:48	first attempt to sample			
11:56:47	sample in box 4; <b>09°34,37'S 13°12,95'W</b> ; water depth 1454 m	194ROV-1	old pillow basalt	
12:04:23	biology on pillow, several pictures taken,			
12:04:55	move 30 m east			
12:05:34	from time to time, similar "dendritic" structures on pillows			
12:09:18	start testing the pumping system, move handle out of holding position			
12:15:34	big fish approaching ROV			
12:17:53	pump on, bottle 15			
12:19:47	while pumping, move 30 m east			
12:20:29	Pteropod shells on sediment between pillows			
12:21:12	laser on			
12:21:54	move another 30 m east			
12:22:16	larger area with sediments: Pteropod shell fragments			
12:23:42	pump out, reset, then move to bottle 10			
12:24:22	pump on, fill bottle 10			
12:24:56	Gorgonaria on pillow, Echinoderm on Gorgonaria			
12:26:27	many pillows covered with biology: Gorgonaria			
12:27:39	densely populated pillows			
12:29:18	well developed Gorgonaria			
12:29:43	pump off, wait 5 seconds, move to bottle 12			
12:30:11	pump on, fill bottle 12			
12:34:48	nozzle fell out of Orion			
12:35:45	move to bottle 13 while pumping			
12:39:33	zoom into white Gorgonaria (white=dead), Crinoid on top (looks like palm tree), also two Ophiuroideu, one Hermit Crab			
12:40:39	move to bottle 14 while pumping	194ROV-2	water sample	
12:43:59	densely populated pillows around			
12:47:00	pump out, move to reset position (all fluid samples:194 ROV 2)			
12:51:41	nozzle back in holder position			
	moved 135 m from start of pumping, position: 09°34,37'S, 13°12,86'W			
12:54:01	Niskin 1 closed	194ROV-3	Niskin	
12:55:50	collect a rock sample			
13:05:39	still trying to recover sample			
13:06:45	rock sample successfully recovered, placed in box 6, water depth 1429 m, position: <b>09°34,37'S, 13°12,86'W</b>	194ROV-4	basalt	
13:09:20	collect piece of the Gorgonaria, place into large box, water depth 1429 m, position: 09°34,37'S, 13°12,86'W	194ROV-5		
13:15:04	move 30 m east			
13:18:56	move across a ridge flank, water depth now 1447 m			
13:20:07	looking east across a pillow field, relief going up again			
13:22:55	moving up hill, depth 1430m, numerous gorgonaria			
13:24:28	stopped, closeup movie of ??gorgonaria			
13:27:10	moving east along flank of mound, large pillows 1m wide, slightly sedimented			
13:32:40	moving downhill, more talus, depth: 1436m			
13:33:30	prepare to collect rock sample			
13:36:04	turned north to collect grey old pillow material			
13:39:40	first attempt to sample failed			
13:40:54	recovered small piece; <b>09°34.37'S / 13°12.77'W</b> , depth 1436m; sample in box 1	194ROV-6	small pc of pillow basalt	
13:44:44	start movin' again, turning east, pillows and tubes, little sediment, abundant gorgonaria			
13:47:06	pillows and tubes, little sediment, abundant gorgonaria, slope down to the north			
13:48:51	positioning to take foto of gorgonian forrest			
13:51:32	moving east along local high, slope doen to the north, pillows			
13:51:56	steep slope ahead, only few metres, depth:1418m			
13:52:46	hdg east on slope down north, pillows			
13:55:38	small N/S trending scarp			



Meteor M64/1 ROV-Protokolle

Station No:	194 ROV Dive 46	ME-64/1		
Segment (area):	9°34'S volcanic area; target: west to east exploration within axis area, with few mounds and apparent younger lava flow			
	Date: 24. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
13:56:31	another small scarp N/S, always 1-2 meters down stepping, depth 1424m			
13:57:08	next step, this time larger, depth 1429m			
13:58:16	depth 1440m, blue sky			
13:59:11	pillow tubes, hdg east, depth: 1447m			
14:00:30	compass off, for sampling			
14:10:35	pillow fragment recovered; <b>09°34.37'S / 13°12.67'W</b> , depth 1448m; sample in box 6	194ROV-7	pillow fragment	
14:18:31	flying east			
14:19:35	fish in the background			
14:21:41	pillow and lobate flows - no sediment			
14:25:19	fish - Bythitidae			
14:32:33	flying north - about 8m above ground			
14:36:56	checking cabel			
14:39:36	cabel seems to be ok, thus flying east again			
14:43:20	Gorgonaria on pillow			
14:47:54	tallus on steep slope			
14:52:51	collecting another rock sample			
14:56:16	angular piece from tallus recovered, placed into large box	194ROV-8	tallus piece	
14:57:20	<b>09° 34,41'S, 13° 12,53'W</b> , water depth 1465 m			
15:02:13	looking down a "canyon", estimated depth 10m, direction NE-SW			
15:12:00	flying above an area with lobate lava			
15:15:03	wanting to collect another rock sample			
15:24:24	old collapse pit, and fish			
15:27:27	solving cable problems (cable on the ground)			
15:33:56	occasional crinoids on lobate lava			
15:44:54	large fractured pillow			
15:47:42	finally trying to collect a rock sample			
15:58:35	small piece successfully collected, rim of very large pillow, 1465 m	194ROV-9	pillow rim fragment	
16:01:03	sample in large box, broken into pieces, sampling position: <b>09°34,43'S, 13°12,52'W</b>	difficult to distinguish between samples that were deposited previously		
16:06:14	moving 100m north, trying to find fresher lava flow			
16:15:56	still pillows and lobate lava flows, no sediment, few gorgonaria and crinoids			
16:17:57	collapse pit			
16:20:07	moving 30m into direction 60°, water depth 1471m			
16:22:39	moving again further towards northeast			
16:25:19	approaching small elevated area , sheet flow on top of pillows			
16:30:27	jumbled lava, small fissure			
16:31:31	sheet flow (main lava channel?) with jumbled flows at the edges			
16:33:20	main sheet flow is fractured, no apparent age difference between small pillows and large flow			
16:37:27	prepare to collect rock sample from top of large sheet flow, main lava channel			
16:44:34	sampling successful; sample in box 2, <b>09° 34,37'S, 13° 12,50'W</b> , water depth 1470 m	194ROV-10	sheet flow rim, 2 pieces	
16:49:23	turning north, jumbled flows ahead			
16:50:09	moving along 060, small pillows			
17:00:50	sampling not successful			
17:01:56	aiming for another sampling site			
17:04:40	sampled small pillows; sample in box 3; <b>09° 34,38'S, 13°12,49'W</b> , water depth 1470 m	194ROV-11	pillows	
17:10:31	take off, hdg 090			
17:10:46	unsedimented pillows to lobes, small diameter, heading east			
17:12:07	collapse pit with pillows in sheet flow surface			
17:13:13	sheet flow with pit texture (small depressions)			
17:14:19	fish, increasing pillows			
17:16:22	unsedimented pillows to lobes, small diameter, heading east			
17:18:01	on slightly sedimented sheet flow surface, sediment in cracks, small pits			
17:21:00	pillow field, drastic change in morphology from sheets to pillows, depth 1467m			
17:24:21	gentle slope up in the northeast			
17:26:06	still on pillow field, very extensive, camera failure, depth 1460m			
17:29:10	pillow field, depth 1457m			
17:29:33	on edge of ridge?, on pillow field, moving downhill, depth 1459m			
17:30:36	pillows, lobes and tubes, depth 1461m			
17:33:09	broken pillows, depth 1462m			
17:34:37	stopped, waiting for ship?, pillow field			
17:36:33	prepare to take sample, will stop dive after this sampling; pumping at 200m if necessary			
17:48:00	big pillow fragment; sample in box 5; <b>09° 34,38'S, 13°12,34'W</b> , water depth 1460 m - pillow broke and several pieces fall into other boxes...	194ROV-12	pillows	
17:55:35	flying north to get closer to the ship			
18:04:33	collapse structure, lava pillars, crinoid			
18:20:44	big pillow fragment placed on top of ROV next to the NISKIN bottles; <b>09° 34,38'S, 13°12,34'W</b> , water depth 1468 m	194ROV-13	pillows	
18:30:33	ROV is coming up			
20:50:59	ROV on deck			

Meteor M64/1 ROV-Protokolle

Station No:	200 ROV Dive 47	ME-64/1		
Segment (area):	9°33'S volcanic area; target: exploration within axis area and apparent younger lava flow			
	Date: 25. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
8:03:22	~ begin station			
8:34:21	ROV in the water, water depth 1500m HS			
8:37:51	pump on			
9:01:02	pump off			
9:17:49	ROV at 1000m, going down			
9:37:55	bottom sight, sedimented pillows, sed 30% in patches and depressions, depth 1469m			
9:47:19	current position: 09°32.99'S / 13°12.92'W			
9:49:42	preparing to take sample			
9:55:10	elongated tubes, abundant gorgonaria, single red shrimp			
9:57:27	sampling successful, sampled placed in box 6; <b>09°32.99'S / 13°12.92'W</b> ; depth 1469m	200ROV-1	pillow fragment with fauna	
10:02:41	turning to E, 30 m to the east, depth 1470m on gentle slope			
10:03:35	large pillows, thick sediment in between			
10:04:14	slope is upward to N, numerous dead (partly blackened) gorgonaria			
10:05:54	another 30 m east, patches of pteropode-shell sediment, depth 1464m			
10:07:15	local high, depth 1459m, large broken pillows with sediment in between, pteropode shells			
10:08:19	another 30 m to the East, numerous live and dead (partly blackened) gorgonaria			
10:09:25	slope is still there upwards to north, less sediment due to local current regime			
10:13:34	foto shooting of gorgonaria. they are N/SW oriented, = local current = E/W			
10:22:56	want to move east again, another 30 m towards rift valley, depth 1456m			
10:31:39	slope down ahead			
10:32:15	start moving east, sedimented pillows			
10:33:24	slowly going down, depth 1459m			
10:33:42	steep cliff ahead, down,			
10:35:05	going down N/S trending fault scarp, 1470m, turined vehicle west for descent			
10:36:09	going down N/S trending fault scarp, 1480m			
10:36:23	talus material at base, depth 1490m, turning back east, scarp height=30m			
10:38:54	descending on talus slope, 1500m			
10:40:37	still on talus, very extensive!!, 1518m			
10:41:15	contact to sedimented basement floor			
10:41:50	jumbled material, small ridge on sedimented plain with pteropode shells, 1525m			
10:43:14	sheet flows ahead, depth constant at 1525m			
10:44:32	increasing pillows			
10:44:57	contact to talus, trying to take sample			
10:48:55	sampling successful, sampled placed in box 4; <b>09°32.96'S / 13°12.80'W</b> ; depth 1523m	200ROV-2	angular talus piece	
10:52:07	moving east, talus with few rounded pillows			
10:52:39	climbing up slope, 1518m			
10:53:51	climbing up slope, 1502m			
10:54:47	near top 1476m, very narrow at top, steep slope down on other side			
10:57:48	turning west to descent on other side of narrow ridge			
10:58:43	going down talus slope. touched other wall behind us, very narrow cleft			
11:01:01	over the top, next fissure, 1485m			
11:02:18	only slightly sedimented pillows, steep slope ahead			
11:03:50	turning west to descent on other side of local high			
11:04:32	touch down on pillows, nice soccer balls			
11:05:21	pillows are less sedimented, depth 1505m			
11:07:11	lava more lobate, depth 1501			
11:07:55	planing to collect a sample of collapsed pillow			
11:14:52	sampling difficult, material extremely fragile and crumbled			
11:20:00	take out shovel			
11:26:59	it does not work !			
11:29:50	successfully sampled the rim of a fractured pillow, sample placed in large box, depth 1505m, <b>09°32,90'S, 13°12,72'W (GAPS)</b>	200ROV-3	pillow rim	
11:35:47	heading east			
11:36:51	pillows with individual gorgonaria			
11:38:52	small fish inbetween pillows and lobate lava, depth 1494m			
11:41:10	stronger relief			
11:41:35	gorgonaria			
11:45:24	brownish coloured/covered lava fragments over quite an area			
11:50:24	slightly sedimented pillows, 1493m			
11:53:39	fissured terrain heading 320, turning SW			
11:55:15	on pillow field, stopped			
11:59:09	large grey pillows, hdg east, start moving			
11:59:56	small fissure, NW/SE trending			
12:00:46	more lobate flows			
12:02:09	pillows and lobate flows, hdg 064, depth 1496m			
12:03:07	pillows overly sheet flow, stopped			
12:07:50	heading south to retrieve cable, lobate flows			
12:11:30	younger lava flow with <b>bathymodiolus shells</b> in fractures and depressions, dead and live?			
12:15:54	position: <b>09°32.94'S / 13°12.52'W</b> , depth 1494 m			
12:20:08	will try to take net for sampling			
12:39:29	sampling successful: <b>09°32.93'S / 13°12.51'W</b> , depth 1494m, net into box 4	200ROV-4	bathy shells	
12:52:27	will take 100µm net for sampling of Fe-oxyhydroxides			

Meteor M64/1 ROV-Protokolle

Station No:	200 ROV Dive 47	ME-64/1		
Segment (area):	9°33'S volcanic area; target: exploration within axis area and apparent younger lava flow			
	Date: 25. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
13:01:47	fished net through porous Fe-oxyhydroxides; <b>09°32.93'S / 13°12.51'W</b> , depth 1494m, sample in box 1	200ROV-5	Fe-oxyhydroxides	
13:06:22	start moving again, pillows, fractures partly filled with Fe-oxyhydroxides, patchy shells areas			
13:07:14	will take rock sample of red-stained large pillows			
13:14:01	first attempt failed, will try again			
13:16:28	still looking for best spot to sample			
13:26:01	giving up? hdg east			
13:27:57	then north, pillows			
13:30:48	stopped at another shell pad			
13:35:54	?? Tiefseeanglerfisch			
13:37:50	gorgonaria			
13:39:33	conductivity decreases (34,2 mS)			
13:40:14	heading west			
13:41:35	more patches of dead bathymodiolus			
13:43:18	lobate and pillow lava, more shell patches, but only empty shells			
13:46:39	continue heading west			
13:48:35	move northward now			
13:49:23	patches of <b>iron oxide crusts</b> and some sediment in between lava, no mussel shells			
13:50:22	conductivity decreases further (33,84 mS)			
13:52:22	an area with <b>massive occurrences of iron oxide crusts</b> and staining on basalts			
13:55:14	conductivity decreases further (33,56 mS)			
13:58:58	heading east, oops, the cable			
14:04:28	heading south			
14:07:59	heading west			
14:11:10	lost the GAPS system, moving back to iron oxide crust area, continue from there			
14:12:51	move 20m north			
14:14:12	move 20m west			
14:15:38	fragmented large lava blocks			
14:16:04	move 10m north			
14:17:04	very fresh lava, several gorgonaria			
14:21:20	possible sampling spot, taking several photos first, depth 1496m			
14:24:57	collecting rock sample, not so very fresh lava as before (14:17:04)			
14:27:25	successful sampling, 1496.1m, sample in box no.3, <b>09°32,92'S, 13°12,53'W</b>	200ROV-6	pillow fragment	
14:31:06	heading north, looking for fresh basalt			
14:33:22	move 10m west, then turn south			
14:33:52	found the area with intense iron oxide crusts and staining			
14:35:24	move 5m east, then turn northwards			
14:36:17	move 10m north, flying over patches with iron oxide crusts, also sediments			
14:38:30	two larger collapse structures filled with brownish material - ? Fe oxides			
14:42:03	rectangular shaped collapse (looks like grave), 60cm x 200cm, 1495m depth			
14:45:15	continue to move north			
14:47:52	turning to east, move 20m eastward			
14:48:27	large collapsed lava domes			
14:49:02	large pillows, no sediment			
14:50:45	in between pillows, brown patches indicate (?) old discharge sites for temperate fluids			
14:54:45	10m north, then westwards			
14:56:15	again areas with brownish staining			
15:00:34	diffuse discharge sites, only Fe oxides			
15:01:29	trying to sample the Fe oxide crust/chimneys			
15:12:42	push core not successful, continue to move north			
15:18:47	sediment and small, dark brown Mn-Oxide structures			
15:21:18	Grenadier fish			
15:23:17	trying to sample the Fe oxide crust/chimneys with Schottli's shovel			
15:25:24	too much, too thick Fe oxide crusts, may be fully oxidized sulfide chimney/mound			
15:27:41	conductivity now at 31 mS - something wrong with recording ?			
15:40:00	Fe oxide structure sampled with shovel, 1495m depth			
15:48:55	sample placed in box 5, <b>09°32,88'S, 13°12,55'W (GAPS: 09°32,86'S, 13°12,53'W)</b>	200ROV-7	Fe-oxyhydroxides	
15:50:47	moving west 10m			
15:51:43	moving west another 10m			
15:52:28	now back into fresh lobate basalts			
15:53:05	estimated size of Fe oxide area: 25 m diameter			
	<b>DISCOVERY !!!</b>			
<b>15:54:52</b>	<b>patches of living mussels - bathymodiolus, small ones, small chimney structures</b>			
	<b>GAPS: 09°32,850'S, 13°12,540'W</b>			
15:58:36	young mussels, may be young field			
16:00:05	thin clear white structure, may be a sponge			
16:04:08	temperature at 4°C			
16:05:36	temperature stays around 4°C			
16:06:44	cracks between pillows completed covered with mostly young mussels			
16:09:23	temperature at 4°C			
16:12:03	in between pillows, mussels, also several gorgonaria			
16:23:18	Niskin 1 closed, 1495m, 09°32,86'S, 13°12,56'W (Doppler)	200ROV-8	Niskin 1	

Meteor M64/1 ROV-Protokolle

Station No:	200 ROV Dive 47	ME-64/1		
Segment (area):	9°33'S volcanic area; target: exploration within axis area and apparent younger lava flow			
	Date: 25. April 05			
Time (hh:mm:ss)	Notes	CODE	SAMPLE	
16:30:47	collecting mussle sample from rock cracks (4.1°C; 1495m); alterierte pillows mit Eisenoxyd			
16:38:05	biological sampling of mussel field, temperature at 4,35°C			
16:45:10	sampling successful, depth 1495.0m, sample in large box, <b>09°32,86'S, 13°12,56'W</b>	200ROV-9	Bathymodiolus	
16:50:16	continue to move west, pillows with cracks overgrown with small young mussels			
16:55:06	pillow cracks covered with biofilm			
16:59:27	moving north for 40m in 20° direction, still full of Fe oxides			
16:59:34	looking east			
16:59:52	moving east for 10m			
17:00:47	moving east for another 10m			
17:01:48	rough Fe oxide crusts continuing			
17:01:58	continue to move east			
17:03:16	slowly losing Fe oxides, area is 30m wide			
17:03:33	move north for 10m			
17:04:33	bottom current direction: SE to NW			
17:05:22	move westward, parallel to previous track			
17:05:34	Grenadier fish, 1495m			
17:06:55	moving across area with Fe oxide crusts again, but not so abundant in between pillows, no mussels			
17:07:46	turning direction 170°, returning to mussel fields			
17:11:33	having moved 40m, still 15m to go			
17:13:57	arrived at mussel fields, searching for fluid sampling site			
17:17:29	preparing for fluid sampling a little bit away to avoid dust at sampling site			
17:33:42	Quest changes the pilots - waiting for a moment			
17:36:16	flying to search a good place for fluid sampling			
17:37:05	start fluid sampling, trying to put the snorkel in fluid spring			
17:38:50	temperature increase on 4,1 °C			
17:39:52	temperature increase on 4,2 °C			
17:40:44	start pumping, shimmering water			
17:44:43	temperature 4,3°C			
17:46:53	two shrimps			
17:55:20	Mini shrimp aufgesaugt			
17:56:54	shrimps in between mussels			
18:25:10	crap appears			
18:26:30	temperature 4.5°C			
18:30:00	temperature 5.1°C			
18:41:31	end of fluid sampling	200ROV-10	diffuse fluid	
18:41:44	will take Niskin bottle at same site			
18:47:39	fotoshooting of snails			
18:50:48	Niskin 2 closed, 1495m, <b>09°32,84'S, 13°12,54'W</b> (Doppler)	200ROV-11	Niskin 2dots	
18:55:16	exploring to 330			
18:57:40	pillows with thick Fe-Mn crusts			
18:58:22	number of crusts is decreasing, but still 30% crusts			
18:59:53	elongated ridge of Fe-crusts			
19:00:59	broken pillows, moved 60 to 330, will move another 30m in 330			
19:02:18	pillows, no crusts			
19:03:34	pillows, no crusts			
19:14:08	moved 30 m to 330			
19:14:48	moving 20 m to west, pillows, little sediment			
19:17:30	moving 30m north, pillows, depth 1500m			
19:22:37	moving 30m east, pillows			
19:26:01	moving 30m north, pillows, depth 1500m			
19:27:27	pillows			
19:28:22	Fe-staining in between pillows, possible snail			
19:29:22	20m to 330, exploring			
19:30:19	red staining on fractures of pillows			
19:31:49	turning around, surrounded by pillow field, 1496m			
19:32:36	hdg east			
19:33:53	30m to the west!!			
19:37:53	pillows with some Fe-staining, going north			
19:38:31	more staining, 30%, moving 30 m east			
19:41:19	pillows, pillows, pillows .... ..			
19:45:05	will take rock sample than finish dive			
19:48:08	angular piece from fracture in pillow (pillow section), sample in large box: <b>09°32.71'S / 13°12.55'W</b> , depth 1495m	200ROV-12	pillow	
19:55:01	coming up			
19:55:30	lost bottom sight			
21:10:00	ROV on deck			

M64/1  
Water column samples

Station	Instrument	Position*		Water depth* [m]	CTD/Rosette bottle no.																							
		Lat(S)	Long (W)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
111	CTD	04°48,6'	12°22,4'	2998	B	C	B	B	B	BC	B	C	B	B	B	B	C	B	B	B	B	B	C	B	B	B	B	B
116	CTD	04°48,8'	12°22,7'	2961	AC	B	A	B	AC	B	A	B	A	B	A	B	A	B	A	B	AC	B	A	B	A	B	AC	AB
121	CTD	04°47,8'	12°22,6'	3022	A	AC	B	A	B	AC	B	A	B	A	B	A	AC	B	A	B	AC	B	A	B	A	B	A	B
122	CTD	04°48,5'	12°22,4'	2971	B	A	B	A	B	A	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	AC	AB	AB	AB
126	CTD	04°46,8'	12°23,2'	3063																								
127	CTD	04°48,7'	12°23,0'	2959	A	A	A	A																				
128	CTD	04°48,8'	12°22,4'	2967	A	A	A	A																				
129	CTD	04°48,6'	12°22,6'	2982																								
133	CTD	04°48,6'	12°22,4'	2966	AC	B	A	B	AC	B	AC	B	AC	B	A	B	A	AC	B	A	B	A	B	A	B	A	B	
138	CTD	04°47,8'	12°22,6'	2971	A	AC	B	A	B	AC	B	AC	B	A	B	A	B	A	AC	B	A	B	A	B	A	B	A	B
145	CTD	04°48,9'	12°22,8'	2974	A	B	A	B	AB		A	B	A	B	A	B	A	B	A	B	A	B	AB	B	B	B	A	B
154	CTD	08°47,0'	13°31,0'	2182	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
164	CTD	08°54,0'	13°29,2'	2122	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
177	CTD	09°10,5'	13°26,1'	2654	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
178	CTD	09°10,4'	13°25,0'	2582	B																							
186	CTD	09°19,0'	13°17,0'	1932	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
187	CTD	09°19,0'	13°15,0'	2059	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
189	CTD	09°27,0'	13°14,0'	1701	A	B	A	B	A	B	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
190	CTD	09°27,0'	13°16,0'	2083	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
191	CTD	09°27,0'	13°12,0'	1886	A	B	A	B	A	B	AB	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
192	CTD	09°30,0'	13°13,0'	1653	A	B	A	B	A	B	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
193	CTD	09°32,5'	13°12,9'	1458	A	B	A	B	A	B	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
195	CTD	09°34,5'	13°12,5'	1402	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
196	CTD	09°31,5'	13°13,0'	1550	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
197	CTD	09°33,9'	13°12,7'	1477	A	B	A	B	A	B	A	AB	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
199	CTD	09°33,0'	13°12,9'	1473	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
206	CTD	09°33,3'	13°12,5'	1469	A	B	A	B	A	B	AB	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
208	CTD	09°32,8'	13°12,6'	1501	AC	B	A	B	A	B	AB	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
216	CTD	09°32,8'	13°12,9'	1509	AC	B	A	B	A	B	ABC	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A

\*data from station protocol

A: gas chemistry, DIC

B: trace elements, sulphur isotopes

C: amino acids, NH4

M64/1  
Table of fluid samples

Station	114	123	125	130	141	146	200
<b>Instrument</b>	ROV	ROV	ROV	ROV	ROV	ROV	ROV
<b>Location</b>	Turtle Pits	Turtle Pits	Wideawake	Turtle Pits	Turtle Pits	Red Lion	Liliput
<b>Lat (S)*</b>	04°48,6'	04°48,6'	04°48,6'	04°48,6'	04°48,6'	04°47,8'	09°32,6'
<b>Long (W)*</b>	12°22,4'	12°22,4'	12°22,4'	12°22,4'	12°22,4'	12°22,6'	13°12,5'
<b>Water depth* [m]</b>	2998	2998	2995	2998	2998	3048	1495
<b>N1</b>	ABD	ABD	ABD	-	ABCD	ABCD	ABCD
<b>N2</b>	ABD	ABCD	ABCD	-	ABCD	ABCD	ABCD
<b>N3</b>	ABCD	ABCD	ABCD	-	ABC	ABD	-
<b>B1</b>	-	-	-	-	-	B	-
<b>B2</b>	-	-	-	-	-	B	-
<b>B3</b>	-	-	-	-	-	B	-
<b>B4</b>	-	-	-	-	-	B	-
<b>B5</b>	-	-	-	-	-	B	-
<b>B6</b>	-	-	-	-	-	AB	-
<b>B7</b>	-	-	-	-	-	AB	-
<b>B8</b>	-	-	-	-	-	BCD	-
<b>B9</b>	-	-	-	-	-	B	-
<b>B10</b>	-	-	-	-	-	B	-
<b>B11</b>	-	BCD	B	-	B	B	B
<b>B12</b>	-	-	B	-	B	BC	B
<b>B13</b>	-	-	B	-	BCD	-	CD
<b>B14</b>	-	-	B	-	B	-	A
<b>B15</b>	-	BC	CD	-	B	-	A

\*data from station protocol

A: gas chemistry, DIC

B: trace elements

C: sulphur isotopes

D: amino acids, NH4

M64/1  
List of zoological samples

Nr.	Station / Sample	Date	Time	Location	Depth	Lat.	Long.	Content
1	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	juvenile Bathymodiolus
2	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Polychaetenröhren
3	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Aufwuchs von Basalt
4	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Polychaeten
5	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Actinie (groß)
6	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	kleine Actinien auf Basalt
7	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Limpets
8	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Holothurien & Diverses
9	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Eikapseln von Phymorhynchus
10	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Sediment für Meiobenthos
11	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Individuen v. Rimicaris
12	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	1 Individuum v. Chorocaris
13	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	kleine Actinien auf Basalt
14	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Muschelklappen
15	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 1(8), Doppelklappe
16	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 2(8), Doppelklappe
17	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 3(8), Doppelklappe
18	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 4(8), Doppelklappe
19	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 5(8), Doppelklappe
20	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 6(8), Doppelklappe
21	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 7(8), Doppelklappe
22	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	Bathymodiolus 8(8), Doppelklappe
23	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	ca. 20 Individuen v. Bathymodiolus
24	109GTV-A	09.04.20005	00:58	Widawake Mussel Field	2998m	12°22,36W	04°48,64S	ca. 20 Individuen v. Bathymodiolus
25	114 ROV #6	10.04.2005		Turtle Pits / Tower	2987m			1 Chorocaris, 2 Rimicaris
26	123 ROV #5 +#6	11.04.2005	15:01 / 15:11	Turtle Pits / Tower	2992m			1 Rimicaris Weibchen mit Eiern
27	123 ROV #5 +#6	11.04.2005	15:01 / 15:11	Turtle Pits / Tower	2992m	Gaps out of order		4 adulte Rimicaris
28	123 ROV #5 +#6	11.04.2005	15:01 / 15:11	Turtle Pits / Tower	2992m			2 Mirocaris
29	123 ROV #5 +#6	11.04.2005	15:01 / 15:11	Turtle Pits / Tower	2992m			Copepoda von Shrimps + Limpets
30	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Restprobe
31	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Polychaetenröhren
32	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Limpets
33	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Limpets
34	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Bythograeidea (Männchen, juv.)
35	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Pantopoda
36	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Polychaeta
37	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Bathymodiolus
38	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Bathymodiolus 1(3) Doppelklappe
39	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Bathymodiolus 2(3) Doppelklappe
40	125ROV #1	12.04.2005	11:38	Widawake Mussel Field (Musselpatch)	3000m	12°22.33W	4°48,61S	Bathymodiolus 1(3) Doppelklappe
41	125ROV #2	12.04.2005	11:46	Widawake Mussel Field (Musselpatch)	3000m	12°22.36W	4°48,62S	Polychataröhren
42	125ROV #2	12.04.2005	11:46	Widawake Mussel Field (Musselpatch)	3000m	12°22.36W	4°48,62S	Terebellida

M64/1  
List of zoological samples

Nr.	Station / Sample Box	Fixed with	Comment
1	109GTV-A	Kautex 50ml	Formol 4%
2	109GTV-A	Kautex 1000ml	Formol 4%
3	109GTV-A	Kautex 1000ml	Formol 4%
4	109GTV-A	Kautex 50ml	Formol 4%
5	109GTV-A	Kautex 50ml	Formol 4%
6	109GTV-A	Kautex 50ml	Formol 4%
7	109GTV-A	Kautex 50ml	Formol 4%
8	109GTV-A	Kautex 50ml	Formol 4%
9	109GTV-A	Kautex 50ml	Formol 4%
10	109GTV-A	Kautex 50ml	Formol 4%
11	109GTV-A	Kautex 50ml	Ethanol 72%
12	109GTV-A	Kautex 50ml	Ethanol 72%
13	109GTV-A	Kautex 50ml	Ethanol 72%
14	109GTV-A	Kautex 500ml	Ethanol 72%
15	109GTV-A	Kautex 500ml	Ethanol 72%
16	109GTV-A	Kautex 500ml	Ethanol 72%
17	109GTV-A	Kautex 500ml	Ethanol 72%
18	109GTV-A	Kautex 500ml	Ethanol 72%
19	109GTV-A	Kautex 500ml	Ethanol 72%
20	109GTV-A	Kautex 500ml	Ethanol 72%
21	109GTV-A	Kautex 500ml	Ethanol 72%
22	109GTV-A	Kautex 500ml	Ethanol 72%
23	109GTV-A	5l-Eimer	Formol 4%
24	109GTV-A	5l-Eimer	Formol 4%
25	114 ROV #6	Kautex 500ml	Ethanol 72%
26	123 ROV #5 +#6	Kautex 50ml	Ethanol 72%
27	123 ROV #5 +#6	Kautex 500ml	Ethanol 72%
28	123 ROV #5 +#6	Kautex 50ml	Ethanol 72%
29	123 ROV #5 +#6	Kautex 50ml	Ethanol 72%
30	125ROV #1	Kautex 50ml	Formol 4%
31	125ROV #1	Kautex 50ml	Formol 4%
32	125ROV #1	Kautex 50ml	Formol 4%
33	125ROV #1	Kautex 50ml	Ethanol 72%
34	125ROV #1	Kautex 50ml	Formol 4%
35	125ROV #1	Kautex 50ml	Formol 4%
36	125ROV #1	Kautex 50ml	Formol 4%
37	125ROV #1	5l-Eimer	Formol 4%
38	125ROV #1	Kautex 500ml	Ethanol 72%
39	125ROV #1	Kautex 500ml	Ethanol 72%
40	125ROV #1	Kautex 500ml	Ethanol 72%
41	125ROV #2	Kautex 1000ml	Formol 4%
42	125ROV #2	kl. PE Röhre	Ethanol 72%

Weichkörper wurde von Prof. Giere für Genetik entnommen, an AG Dubilier (MPI Bremen) ging Gewebe für Untersuchungen an Symionten, an Tim Shank (WHOI) Gewebe (Fuß und Muskel) für Untersuchungen des Wirtes

Fanggerät: 123ROV#5 Netz 100µm, 123ROV#6 300µm, gleiche Lokation; fotografiertes Fanggerät: 123ROV#5 Netz 100µm, 123ROV#6 300µm, gleiche Lokation

2 Archinome, 2 Branchipolynoe, 2 Terebellida an Christian Osterberg- Henning für Amino

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M64/1  
List of zoological samples

Nr.	Station / Sample	Date	Time	Location	Depth	Lat.	Long.	Content
43	125ROV #2	12.04.2005	11:46	Widawake Mussel Field (Musselpatch)	3000m	12°22.36W	4°48,62S	2 St. Archinome sp.
44	125ROV #2	12.04.2005	11:46	Widawake Mussel Field (Musselpatch)	3000m	12°22.36W	4°48,62S	2 St. Gastropoda
45	125ROV #2	12.04.2005	11:46	Widawake Mussel Field (Musselpatch)	3000m	12°22.36W	4°48,62S	Pantopoda
46	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Bruchstück v.Calyptogena, 1 Bathymodiolus (juv.)
47	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Calyptogena 1(3)
48	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Calyptogena 2(3)
49	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Calyptogena 3(3)
50	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Bathymodiolus 1(3) Doppelklappe
51	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Bathymodiolus 2(3) Doppelklappe
52	125ROV #7	12.04.2005	14:25	Widawake Mussel Field (Musselfield)	2985m	12°22.35W	4°48,65S	Bathymodiolus 1(3) Doppelklappe
53	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bythograeidea (adultes Männchen)
54	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Limpets
55	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 1(6) Doppelklappe
56	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 2(6) Doppelklappe
57	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 3(6) Doppelklappe
58	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 4(6) Doppelklappe
59	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 5(6) Doppelklappe
60	125ROV #12	12.04.2005	17:41	Widawake Mussel Field (Musselfield)	2980m	12°22.36W	4°48,63S	Bathymodiolus 6(6) Doppelklappe
61	130ROV #1	13.04.2005	14:39	Turtle Pits / Marker M2	2989m			Segonzacia mesatlantica (1 Män. adult, 1 Män. juv.)
63	130ROV #1	13.04.2005	14:39	Turtle Pits / Marker M2	2989m			2 Rimicaris
64	130ROV #2	13.04.2005	14:57	Turtle Pits / Marker M2	2989m		GAS out of order	4 Mirocaris
65	130ROV #2	13.04.2005	14:57	Turtle Pits / Marker M2	2989m			2 Pantopoda
66	131 GTV-A	13.04.2005	21:05	Turtle Pits / 5m E vom Stalagmith	2949m	12°22,37W	4°48,57S	Actinien
67	131 GTV-A	13.04.2005	21:05	Turtle Pits / 5m E vom Stalagmith	2949m	12°22,37W	4°48,57S	Polychaetaröhren
68	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Mischprobe, ungesiebt 1(3)
69	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Mischprobe, ungesiebt 2(3)
70	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Mischprobe, ungesiebt 3(3)
71	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Bathymodiolus ca. 20St.
72	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Polychaetaröhren
73	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Segonzacia mesatlantica
74	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Micocaris
75	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Polychaeta
76	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Limpets
77	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Pantopoda
78	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Actinaria auf Basalt
79	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Aufwuchsgeflecht von Basalt
80	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Siebgut von Segonzacia mesatlantica, 40µm
81	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Bathymodiolus ca. 20 St. 1(2)
82	131 GTV-A	14.04.2005	01:36	Wideawake Mussel Field	2996m(HS)	12°22,34W	4°48,62S	Bathymodiolus ca. 20 St. 2(2)
83	139 GTV-A	14.04.2005	20:18	Turtle Pits, Massivsulfide	2990m (HS)	12°22,40W	4°48,58S	Sediment für Meiobenthos, ungesiebt
84	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m	12°22,595W	4°47,824S	37 Rimicaris Weibchen mit Eiern
85	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m	12°22,595W	4°47,824S	42 Rimicaris Weibchen mit Eiern

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List of zoological samples

Nr.	Station / Sample Box	Fixed with	Comment
43	125ROV #2	kl. PE Röhre	Ethanol 72%
44	125ROV #2	kl. PE Röhre	Ethanol 72%
45	125ROV #2	kl. PE Röhre	Ethanol 72%
46	125ROV #7	Kautex 50ml	Ethanol 72%
47	125ROV #7	Kautex 500ml	Ethanol 72%
48	125ROV #7	Kautex 500ml	Ethanol 72%
49	125ROV #7	Kautex 500ml	Ethanol 72%
50	125ROV #7	Kautex 500ml	Ethanol 72%
51	125ROV #7	Kautex 500ml	Ethanol 72%
52	125ROV #7	Kautex 500ml	Ethanol 72%
53	125ROV #12	Kautex 500ml	Ethanol 72%
54	125ROV #12	Kautex 500ml	Ethanol 72%
55	125ROV #12	Kautex 500ml	Ethanol 72%
56	125ROV #12	Kautex 500ml	Ethanol 72%
57	125ROV #12	Kautex 500ml	Ethanol 72%
58	125ROV #12	Kautex 500ml	Ethanol 72%
59	125ROV #12	Kautex 500ml	Ethanol 72%
60	125ROV #12	Kautex 500ml	Ethanol 72%
61	130ROV #1	Kautex 500ml	Formol 4%
63	130ROV #1	Kautex 50ml	Ethanol 72%
64	130ROV #2	Kautex 50ml	Ethanol 72%
65	130ROV #2	Kautex 50ml	Ethanol 72%
66	131 GTV-A	Kautex 50ml	Formol 4%
67	131 GTV-A	Kautex 50ml	Ethanol 72%
68	131 GTV-A	Kautex 1000ml	Formol 4%
69	131 GTV-A	Kautex 1000ml	Formol 4%
70	131 GTV-A	Kautex 1000ml	Formol 4%
71	131 GTV-A	Kautex 1000ml	Ethanol 72%
72	131 GTV-A	Kautex 500ml	Formol 4%
73	131 GTV-A	Kautex 500ml	Formol 4%
74	131 GTV-A	Kautex 50ml	Formol 4%
75	131 GTV-A	Kautex 50ml	Formol 4%
76	131 GTV-A	Kautex 50ml	Formol 4%
77	131 GTV-A	Kautex 50ml	Formol 4%
78	131 GTV-A	Kautex 50ml	Formol 4%
79	131 GTV-A	Kautex 50ml	Formol 4%
80	131 GTV-A	Kautex 50ml	Formol 4%
81	131 GTV-A	18l PE-Eimer	Formol 4%
82	131 GTV-A	18l PE-Eimer	Formol 4%
83	139 GTV-A	Kautex 500ml	Formol 4%
84	146 ROV #6	Kautex 1000ml	Formol 4%
85	146 ROV #6	Kautex 1000ml	Ethanol 72%

vollständig erhaltenes Exemplar  
beschädigte Exemplare, Weichkörper wurde von Prof. Giere für Genetik entnommen, an AG Dubilier (MPI Bremen) ging Gewebe für Untersuchungen an Symionten, an Tim

6 Limpets an Christian Osterberg- Henning für Aminosäurenuntersuchung

Weichkörper wurde von Prof. Giere für Genetik entnommen, an AG Dubilier (MPI Bremen) ging Gewebe für Untersuchungen an Symionten, an Tim Shank (WHOI) Gewebe (Fuß und Muskel) für Untersuchungen des Wirtes

Fotographiert, falsch beschriftet  
1 Exemplar an Olav Giere für genetische Analysen  
4 Exemplare an Olav Giere für genetische Analysen

Basaltaufwuchs  
Basaltaufwuchs

ca. 20St. a Giere für Elektronenmikroskopie

9 kl. Individuen (19-27mm) an Giere für molekularbiologische Untersuchungen

1 Exemplar an Christian Oosterbrg-Hennig für Aminosäurenisotopie

M64/1  
List of zoological samples

Nr.	Station / Sample	Date	Time	Location	Depth	Lat.	Long.	Content
86	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m	12°22,595W	4°47,824S	35 Rimicaris ohne Eiern
87	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m	12°22,595W	4°47,824S	42 Rimicaris ohne Eiern
88	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m	12°22,595W	4°47,824S	Copepoda von Rimicaris Restprobe von präparierten Rimicaris
89	146 ROV #6	16.04.2005	22:57	Red Lion, "Shrimps Smoker"	3048m			
90	155 ROV #5	19.04.2005	14:00	Riftvally, Arbeitsgebiet II	2199m	13°30,06W	8°48,99S	Porifera auf altem Basalt
91	159 ROV #4	20.04.2005	12:16	Riftvally, Arbeitsgebiet II	2201m	13°30,12 W	8°47,99 S	Pteropodenschille
92	159 ROV #7	20.04.2005	15:44	Riftvally, Arbeitsgebiet II	2201m	13°30,21W	8°47,75S	Cnidaria & Octocorallia
93	159 ROV #9	20.04.2005	17:28	Riftvally, Arbeitsgebiet II	2215m	13°30,21W	8°47,50S	Porifera auf altem Basalt, Sheet-fow lava
94	170b VSR	21.04.2005	20:40	Riftvally, Arbeitsgebiet II	2313m (HS)	13°26,99W	9°02,00S	Pteropodengehäuse
95	188 ROV #2	23.04.2005	13:43	Riftvally, Arbeitsgebiet III	1797m	13°04,99W	9°42,48S	Sedimentmischprobe, ungesiebt, Meiobenthos
96	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 1(8) 0-2cm Meiobenthos
97	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 2(8) 2-4cm Meiobenthos
98	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 3(8) 4-6cm Meiobenthos
99	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 4(8) 6-8cm Meiobenthos
100	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 5(8) 8-10cm Meiobenthos
101	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 6(8) 10-12cm Meiobenthos
102	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 7(8) 12-14cm Meiobenthos
103	188 ROV #6	23.04.2005	16:43	Riftvally, Arbeitsgebiet III	1865m	13°04,664W	9°42,382S	Sedimentprobe P8 8(8) 14-16cm Meiobenthos
104	194 ROV #4	24.04.2005	13:06	Vulkane im Riftvally, Arbeitsgebiet III	1429m	13°12,86W	9°34,37S	Porifera auf Basalt
105	194 ROV #5	24.04.2005	13:09	Vulkane im Riftvally, Arbeitsgebiet III	1429m	13°12,86W	9°34,37S	abgestorbene Gorgonarie mit Aufuchs (Neolepas)
106	200 ROV #4	25.04.2005	12:39	Liliput	1494m	13°12,51W	9°32,93S	Schille von Bathymodiolus
107	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 1(8), Doppelklappe
108	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 2(8), mit Kommensale, Doppelklappe
109	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 3(8), Doppelklappe
110	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 4(8), Doppelklappe
111	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 5(8), Doppelklappe
112	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 6(8), Doppelklappe
113	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 7(8), Doppelklappe
114	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus 8(8), Doppelklappe
115	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Polychaeta
116	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Siebgutrest (500µm)
117	200 ROV #9	25.04.2005	16:45	Liliput	1495m	13°12,56W	9°32,86S	Bathymodiolus
118	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Polychaetenröhren
119	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Polychaeten
120	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Polychaetenreste
121	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	juv. Gastropoda
122	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Bathymodiolus
123	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Holothurie
124	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Siebgut >500µm
125	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Siebgut >1000µm
126	213 GTV-A	27.04.2005	01:58	Liliput	1513m	13°12,55W	9°32,83S	Sediment ungesiebt & Dekantat für Meiobenthos

M64/1  
List of zoological samples

Nr.	Station / Sample Box	Fixed with	Comment
86	146 ROV #6	Kautex 1000ml	Formol 4%
87	146 ROV #6	Kautex 1000ml	Ethanol 72%
88	146 ROV #6	Kautex 50ml	Ethanol 72%
89	146 ROV #6	Kautex 50ml	Ethanol 72%
90	155 ROV #5	Kautex 50ml	Formol 4%
91	159 ROV #4	Kautex 50ml	Trockenprobe
92	159 ROV #7	Kautex 50ml	Formol 4%
93	159 ROV #9	Kautex 500ml	Ethanol 72%
94	170b VSR	Kautex 50ml	Ethanol 72%
95	188 ROV #2	Kautex 500ml	Formol 4%
96	188 ROV #6	Kautex 50ml	Formol 4%
97	188 ROV #6	Kautex 50ml	Formol 4%
98	188 ROV #6	Kautex 50ml	Formol 4%
99	188 ROV #6	Kautex 50ml	Formol 4%
100	188 ROV #6	Kautex 50ml	Formol 4%
101	188 ROV #6	Kautex 50ml	Formol 4%
102	188 ROV #6	Kautex 50ml	Formol 4%
103	188 ROV #6	Kautex 50ml	Formol 4%
104	194 ROV #4	Kautex 50ml	Formol 4%
105	194 ROV #5	Kautex 2000ml	Formol 4%
106	200 ROV #4	Kautex 1000ml	Formol 4%
107	200 ROV #9	Kautex 500ml	Ethanol 72%
108	200 ROV #9	Kautex 500ml	Ethanol 72%
109	200 ROV #9	Kautex 50ml	Ethanol 72%
110	200 ROV #9	Kautex 50ml	Ethanol 72%
111	200 ROV #9	Kautex 50ml	Ethanol 72%
112	200 ROV #9	Kautex 50ml	Ethanol 72%
113	200 ROV #9	Kautex 50ml	Ethanol 72%
114	200 ROV #9	Kautex 50ml	Ethanol 72%
115	200 ROV #9	Kautex 50ml	Formol 4%
116	200 ROV #9	Kautex 50ml	Formol 4%
117	200 ROV #9	Kautex 500ml	Formol 4%
118	213 GTV-A	Kautex 500ml	Formol 4%
119	213 GTV-A	Kautex 50ml	Formol 4%
120	213 GTV-A	Kautex 50ml	Formol 4%
121	213 GTV-A	Kautex 50ml	Formol 4%
122	213 GTV-A	Kautex 500ml	Formol 4%
123	213 GTV-A	Kautex 500ml	Ethanol 72%
124	213 GTV-A	Kautex 500ml	Formol 4%
125	213 GTV-A	Kautex 500ml	Formol 4%
126	213 GTV-A	Kautex 1000ml	Formol 4%

1 zerbrochenes Exemplar an Christian Oosterbrg-Hennig für Aminosäurenisotopie

Olav Giere entfernete Mundwerkzeuge und Augen für elektronenmikroskopische Untersuchungen, Arbeitsgebiet II, Vulkane im zentralen Achsenbereich

Basaltaufwuchs  
15ml Schappdeckel in 500ml Kautex Flasche

Probe stammte vom Pushcore P7

Probe stammte vom Pushcore P8, 17cm Kern, je eine Unterprobe an Reitner Uni Göttingen und Immhof, IFM-Geomar, Kiel

Weichkörper wurde von Prof. Giere für Genetik entnommen, an AG Dubilier (MPI Bremen) ging Gewebe für Untersuchungen an Symbionten, an Tim Shank (WHOI) Gewebe (Fuß und Muskel) für Untersuchungen des Wirtes

M64/1  
List of zoological samples

<b>Nr.</b>	<b>Station / Sample</b>	<b>Date</b>	<b>Time</b>	<b>Location</b>	<b>Depth</b>	<b>Lat.</b>	<b>Long.</b>	<b>Content</b>
127	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Gastropoda
128	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Polychaeta
129	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Polychaetaröhren
130	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Bathymodiolus
131	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Bathymodiolus
132	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Siebgut >500µm
133	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Siebgut >1000µm
134	214 GTV-A	27.04.2005	03:33	Liliput	1511m	13°12,54W	9°32,84S	Sediment ungesiebt & Dekantat für Meiobenthos

M64/1  
List of zoological samples

<b>Nr.</b>	<b>Station / Sample Box</b>	<b>Fixed with</b>	<b>Comment</b>
127	214 GTV-A	Kautex 50ml	Formol 4%
128	214 GTV-A	Kautex 50ml	Formol 4%
129	214 GTV-A	Kautex 500ml	Formol 4%
130	214 GTV-A	Kautex 500ml	Formol 4%
131	214 GTV-A	Kautex 500ml	Ethanol 72%
132	214 GTV-A	Kautex 500ml	Formol 4%
133	214 GTV-A	Kautex 500ml	Formol 4%
134	214 GTV-A	Kautex 1000ml	Formol 4%

**Sample list Geology M64/1**

**Abbreviations for sampling equipment**

GTV	TV grab samples
ROV_AC	Accidentally sampled material during ROV dive due to seafloor contact
ROV_P	Sample taken on position with ROV manipulators
VSR	Vulkanit Stossrohr (wax-corer for volcanic rocks)
ROV-PC	Particle Catcher deployed by ROV

**Abbreviations for scientists who took samples/subsamples:**

KH	Karsten Haase
JK	Jan Küver
SP	Sven Petersen
JSch	Jan Scholten
HS	Harald Strauss
CF	Christine Flies
MP	Miriam Perner

Sample ID	Information about station											Sample description	Comments	Sampling record	
	Cruise#	Station	Sample	Sampling equipment	Date <sup>+</sup>	Time <sup>+</sup>	Sample Position				Water depth				Size
						Lat Deg. S	Lat Min.	Long Deg. W	Long Min.						
M64/1	109#	1	GTV	08.04.2005	22:34	4	48.64	12	22.36	2998	30 x 3 0 x 10 cm	Fresh, glassy basalt; aphyric sheet flow.	1.5 cm glass, Fe staining (abundant additional material)	KH, Uni Kiel	
M64/1	109#	2	GTV	08.04.2005	22:34	4	48.64	12	22.36	2998	14 x 16 x 6 cm	Very fresh aphyric sheet flow, wrinkled surface.	1 cm glass, slight Mn staining (abundant additional material)	KH, Uni Kiel	
M64/1	109#	3	GTV	08.04.2005	22:34	4	48.64	12	22.36	2998	10 x 10 x 6 cm	basalt with 1 cm glass crust.	strong Fe staining, older than other samples? (abundant additional material)	KH, Uni Kiel	
M64/1	109#	4	GTV	08.04.2005	22:34	4	48.64	12	22.36	2998	20 x 15 x 15 cm	Piece of fresh, glassy sheet flow lava, wrinkled surface, aphyric.	minor sediment and yellow Fe staining (abundant additional material)	KH, Uni Kiel	
M64/1	109#	5	GTV	08.04.2005	22:34	4	48.64	12	22.36	2998	15 x 10 x 6 cm	Fresh, aphyric sheet lava with 1 cm glass rind on both sides.	some Mn coating of glass	KH, Uni Kiel	
M64/1	110	1	GTV	09.04.2005	2:45	4	48.55	12	22.36	2998	20 x 20 x 10 cm	Fresh, aphyric sheet flow, 1 cm glassy rim.	white to brown staining (abundant additional material)	KH, Uni Kiel	
M64/1	110	2	GTV	09.04.2005	2:45	4	48.55	12	22.36	2998	10 x 10 x 5 cm	Aphyric basalt glass.	very fresh (abundant additional material)	KH, Uni Kiel	
M64/1	110	3	GTV	09.04.2005	2:45	4	48.55	12	22.36	2998	20 x 20 x 10 cm	Fresh aphyric basalt, glassy margins on both sides of sample.	minor Fe staining (abundant additional material)	KH, Uni Kiel	
M64/1	112	1	VSR	09.04.2005	11:05	4	48.75	12	22.28	2995	ca. 2 g	Small glass particles.		KH, Uni Kiel	
M64/1	113	1	VSR	09.04.2005	13:58	4	48.77	12	21.76	2951	3 x 2 x 1 cm	Fresh, aphyric basalt glass.	in addition there are some smaller pieces	KH, Uni Kiel	
M64/1	113	2	VSR	09.04.2005	13:58	4	48.77	12	21.76	2951	ca. 1 g	Fresh glassy ash with foram. sand.		KH, Uni Kiel	
M64/1	114	4A*	ROV-P	10.04.2005	3:55	4	48.579	12	22.418	2993	22 x 18 x 11 cm	Piece of black smoker chimney, zoned, interior consists of chalcopyrite (friable, porous). Outer rim: 1-2 cm of pyrite-marcasite, marcasite-rich outer crust coated with Fe-Oxihydroxides.	Location: southern tower, turtle pits; slabs cut on board	SP, IFM-GEOMAR	
M64/1	114	5A*	ROV-P	10.04.2005	4:20	4	48.579	12	22.418	2993	29 x 20 x 20 cm	Zoned black smoker chimney. Outer 2 - 5 cm: pyrite-marcasite crust, interior; chalcopyrite-rich with abundant anhydrite and rare sphalerite. Prominent ribbon banding. Central conduit is open: 4 to 9 cm in diameter lined and filled by anhydrite (partially intergrown with fine-grained sulfide [sphalerite?]).	Location: southern tower, turtle pits; slabs cut on board	SP, IFM-GEOMAR	
M64/1	114	5B-F*	ROV-P	10.04.2005	4:20	4	48.579	12	22.418	2993	up to 6 cm	Several small pieces of pyrite-marcasite black smoker crustal material, beehive-like layering.	Location: southern tower, turtle pits	SP, IFM-GEOMAR	
M64/1	114	5G-H*	ROV-P	10.04.2005	4:20	4	48.579	12	22.418	2993	up to 5 cm	Porous, friable chalcopyrite-rich material from black smoker interior.	Location: southern tower, turtle pits	SP, IFM-GEOMAR	
M64/1	114	5Bag*	ROV-P	10.04.2005	4:20	4	48.579	12	22.418	2993	loose rubble ca. 1 kg	Loose sulfide rubble, very porous, soft, collected in bionet.	Location: southern tower, turtle pits	SP, IFM-GEOMAR	
M64/1	114	6*	ROV-P	10.04.2005	5:00	4	48.579	12	22.418	2984	20 x 10 x 5 cm + rubble	Sample of beehive structure, similar to sample 114-4; outer marcasite crust, interior is porous chalcopyrite showing beehive layering.	Location: top of southern tower, turtle pits, inactive at sampling	SP, IFM-GEOMAR	
M64/1	114	7*	ROV-P	10.04.2005	5:14	4	48.579	12	22.418	2984	20 x 20 x 10 cm	Piece adjacent to 114-6 but not beehive structured (more like a layered knob); marcasite-rich outer crust; chalcopyrite-rich interior.	Location: top of southern tower, turtle pits, inactive at sampling; slabs cut on board	SP, IFM-GEOMAR	
M64/1	115	1	VSR	10.04.2005	9:10	4	48.77	12	22.61	3048	1 x 1 x 1.5 cm	Basalt glass with large plagioclase phenocryst (10 mm in diameter).		KH, Uni Kiel	

Sample ID	Information about station										Size	Sample description Rock type	Comments	Sampling record Where is the sample:
	Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.				
M64/1	115	2	VSR	10.04.2005	9:10	4	48.77	12	22.61	3048	ca. 2 g	Glass particles with plagioclase phenocrysts.	recovered at the Pb-weight of the corer	KH, Uni Kiel
M64/1	117	1	VSR	10.04.2005	15:05	4	48.25	12	23.00	3033	1 x1 x1 cm	Two small pieces of aphyric basalt glass.		KH, Uni Kiel
M64/1	118	1	VSR	10.04.2005	17:38	4	48.26	12	22.23	3000	several pieces max. diameter is 3 cm	Very fresh aphyric glass.	some additional glass shard together with vaseline	KH, Uni Kiel
M64/1	119	1	VSR	10.04.2005	19:43	4	48.26	12	21.48	2980	5 cm max diameter	Fresh basaltic glass with plagioclase phenocrysts (max. 1 cm).		KH, Uni Kiel
M64/1	120	1	VSR	10.04.2005	21:58	4	47.79	12	22.97	3050	approx. 2 x 3 x 2 cm	~1 cm thick glass crust, basalt with several plagioclase phenocrysts up to 1 cm.	2 large pieces and abundant glass shards	KH, Uni Kiel
M64/1	123	4A*	ROV-P	11.04.2005	13:50	4	48.583	12	22.410	2986	12 x 12 x 10 cm	Outer portion of active chimney consisting of numerous, friable microchimney structures (1 - 5 cm diameter). Marcasite crust. Interior is complex and zoned grading from anhydrite, sphalerite to pyrite-sphalerite to chalcopyrite. Exterior is partially oxidized and locally covered with white bacterial? dots.	Location: marker M1 active black smoker	SP, IFM-GEOMAR
M64/1	123	4B*	ROV-P	11.04.2005	13:50	4	48.583	12	22.410	2986	10 x 7 x 7 cm	Two fragments of chimney interior, chalcopyrite-anhydrite association	Location: marker M1 active black smoker	SP, IFM-GEOMAR; JK
M64/1	123	4C*	ROV-P	11.04.2005	13:50	4	48.583	12	22.410	2986	rubble, max diameter is 5 cm	Various fragments of chimney exterior, marcasite-pyrite + Fe-oxihydroxide + white coatings. Finer rubble with chalcopyrite-rich material, anhydrite, microchimneys.	Location: marker M1 active black smoker	SP, IFM-GEOMAR
M64/1	123	8	ROV-P	11.04.2005	16:26	4	48.58	12	22.40	2985	10 x 6 x 11 cm	Aphyric basalt, lobate feature on surface of jumbled sheet flow. 3 mm thick glass on both sides. Interior is microcrystalline with large lensoidal cavities parallel to outer surfaces (drain-out feature?) lines with thin Mn Oxide film.	Location: ca. 20 m East of marker M1 active black smoker	KH, Uni Kiel
M64/1	123	9*	ROV-P	11.04.2005	16:50	4	48.559	12	22.413	2990	12 x 12 x 8 cm	Piece of inactive sulfide chimney, recrystallized. Chalcopyrite-rich interior ca. 5 cm in diameter, partly oxidized (pigeon coloration). Outer zone is sphalerite-pyrite-marcasite. Crust is marcasite, outer crust is 1 mm thick Fe-oxihydroxide.	Location: beacon site	SP, IFM-GEOMAR
M64/1	124	1A*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	3 piece, largest is 17 x 14 x 7 cm	Three pieces of approx. similar size, slabby blocks of aphyric basalt, 1-2 mm of glass crust on both sides and extensive Fe-oxihydroxide coating.	West of Turtle pits, some sulfide coating most likely due to transport in TV grab together with smoker fragments	SP, IFM-GEOMAR
M64/1	124	1B*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	4 piece, largest is 9 x 20 x 15 cm	Similar to 124-1A but with prominent wrinkles on the surfaces.	West of turtle pits, ropy flow structure	SP, IFM-GEOMAR
M64/1	124	2A*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	1 big piece	Massive pyrite/marcasite; outer 5 mm biogenic(?) marcasite crust followed by 1 cm massive marcasite, interior pyrite: dendritic growth cross cutting beehive layering.	cut in 6 slabs	SP, IFM-GEOMAR; slabs: SP, JSch, HS
M64/1	124	2B*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	1 big piece	Same as 2A + small normal fractures lined with chalcopyrite. Zones of sphalerite enrichment.	cut in 8 slabs	SP, IFM-GEOMAR; slabs: SP, JSch, HS
M64/1	124	2C*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	1 big piece	Same as 2A but interior is with more chalcopyrite (Cu-rich end member of this type).	cut in slabs	SP, IFM-GEOMAR; slabs: JSch, SP
M64/1	124	2 D to M*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	several big pieces	Crustal material of black smoker chimney: pyrite + marcasite, rare to trace sphalerite + chalcopyrite in cavities and along fractures.		SP, IFM-GEOMAR
M64/1	124	2G*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	1 big piece	Similar to 2A but more black sphalerite, Zn-rich end member of this type.		SP, IFM-GEOMAR
M64/1	124	3 A to C*	GTV	11.04.2005	22:11	4	48.573	12	22.424	2998	several big pieces	Massive pyrite-marcasite with strong beehive texture.		SP, IFM-GEOMAR
M64/1	125	1A	ROV-P	12.04.2005	11:38	4	48.61	12	22.33	3000	12 x 4 x 5 cm	Glassy aphyric lava with large vesicle (max. diameter is 5 cm) and some spotty biological coating.		KH, Uni Kiel
M64/1	125	4	ROV-P	12.04.2005	11:59	4	48.61	12	22.33	3000	20 x 4 x 12 cm	Aphyric basalt crust, 4 cm thick, 3 mm glass crust with rough polyhedral joints. Interior is microcrystalline with small vesicles and 3-4 cm thick lower surfaces showing complex plastic deformation and lava stalagmites.	This sample represents the roof of a lava lobe that was at least partially drained.	KH, Uni Kiel
M64/1	125	6	ROV-P	12.04.2005	13:10	4	48.62	12	22.36	2986	5 x 3 x 4 cm, largest piece	Three pieces, basalt overgrown with scyphocytes, aphyric basalt, 2 mm thick glass crust, interior with large vesicles.		KH, Uni Kiel
M64/1	125	8	ROV-P	12.04.2005	16:04	4	48.64	12	22.35	2985	7 x 10 x 8 cm	Aphyric basalt, 3 mm thick glass crust, interior is microcrystalline. Fracture surfaces normal to top of sample are coated with Fe-oxihydroxides.	pillow sector (flow front) of young, glassy dominantly lobate flow covering mussle patches and overlying jumbled flow	KH, Uni Kiel



Sample ID	Information about station										Sample description	Comments	Sampling record	
	Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.				Water depth
M64/1	125	9	ROV-P	12.04.2005	16:19	4	48.63	12	22.36	2986	5 x 5 x 3 cm, largest piece, total ~1 kg	Very fresh glass from flow carapace, abundant quench fractures, <1 vol% olivine phenocrysts, max. diameter ~1mm, locally with elongate to lenticular vesicles up to 2 x 3 cm, no small vesicles.	sample from the older jumbled sheet flow	KH, Uni Kiel
M64/1	125	10	ROV-P	12.04.2005	16:24	4	48.63	12	22.36	2986	some small pieces	Some more fragments of the same type and the same location as sample 125-9 (see above).		KH, Uni Kiel
M64/1	130	1*	ROV-P	13.04.2005	14:40	4	48.570	12	22.417	2985	abundant small pieces, total ca- 500 g, 8 x 7 x 6 cm max. size	There are two types of fragments: 1. Chimney interior consisting of anhydrite and chalcopyrite. 2. Chimney crust consisting of pyrite, chalcopyrite and marcasite, partially covered by Fe-oxihydroxides.	Rock sample in bio net together with vent carb; Marker M2 site	SP, IFM-GEOMAR; HS (sulfide, anhydrite)
M64/1	130	2*	ROV-P	13.04.2005	14:57	4	48.570	12	22.417	2985	9 x 7 x 5 cm	Hollow chimney structure with 2 cm thick walls. Walls consist of cpy and marcasite and a 1-5 mm marcasite crust. Interior of the vent (5 x 3 x 2 cm) is extensively lined by 1-3 mm thick pyrrotine crust with beautiful blade crystals up to 1 mm in diameter.	Rock sample in bio net together with shrimp; Marker M2 site	SP, IFM-GEOMAR
M64/1	130	3*	ROV-PC	13.04.2005	15:34	4	48.570	12	22.417	2985	ca. 5 g	Particles are 5 to <1mm, 75% pyrite particles including some colomorphous aggregates; 10% basalt glass chips (max. 5 mm); 10% anhydrite <1 mm, some larger particles are well-rounded due to resorption by seawater; <5% cpy (altered) and pyrite aggregates, <1% globigerina; rare goethite.	Sample take from M2 marker site black smoker by placing the catcher into the billowing plume for ca. 2 minutes.	HS
M64/1	131	1	GTV	13.04.2005	21:05	4	48.57	12	22.37	2999	20 x 30 x 32 cm3	Piece of aphyric basalt with 1 x 1 cm mafic xenolith. Wrinkled to bulbous crust of a sheet flow with 1 to 5 mm glassy upper surface (locally some Feox-hydrox. staining). Lower surface shows plastic deformation indicating that this is the roof of a lava lobe/tunnel. Xenoliths of gabbro (cpx to 8 mm and plag to 2 mm) up to 5 cm in diameter.	Turtle Pits area	KH, Uni Kiel
M64/1	131	2	GTV	13.04.2005	21:05	4	48.57	12	22.37	2999	10 x 30 x 23 cm3	Similar to 131-1. Crust of drained lava tube. Top surface shows ropy texture; 2 to 3 mm thick glass covered by Fe-Oxihydroxides. Margins of piece are normal fractures covered by Fe-Oxihydroxides and biology.	Turtle Pits area	KH, Uni Kiel
M64/1	131	3	GTV	13.04.2005	22:05	4	48.57	12	22.37	2999	3 x 16 x 4 cm <sup>3</sup>	Similar to 131-1 and 2. Platy slab representing the roof of a drained sheet lava flow. Top is flat and covered by <1 mm hydrothermal(?) crust. Glass is 10 mm thick and shows nice gradation over 3 mm into microcrystalline interior. Lower surface shows lava stalagmites.	Turtle Pits area	KH, Uni Kiel
M64/1	131	4	GTV	13.04.2005	22:05	4	48.57	12	22.37	2999	10 x 4 x 8 cm3	Similar to 131-1,-2, and -3. Lava tongue (4 cm thick) with 1 to 5 mm thick glass on both sides. Top surface is ropy to wrinkled.	Turtle Pits area	KH, Uni Kiel
M64/1	131	5	GTV	13.04.2005	22:05	4	48.57	12	22.37	2999	several pieces up to 5 cm in diameter	Aphyric lava with gabbroic xenoliths: clinopyroxene and plagioclase up to 8 mm.	Turtle Pits area	KH, Uni Kiel
M64/1	132#	1	GTV	14.04.2005	1:36	4	48.62	12	22.34	2996	25 x 25 x 20 cm3	Fresh lava piece, bulbous, aphyric, 10 mm of glass on both sides.	Wideawake Mussle Beds	KH, Uni Kiel
M64/1	132#	2	GTV	14.04.2005	1:36	4	48.62	12	22.34	2996	15 x 10 x 10 cm3	Similar to 132-1, fresh surface with biological colonization.	Wideawake Mussle Beds	KH, Uni Kiel
M64/1	132#	3	GTV	14.04.2005	1:36	4	48.62	12	22.34	2996	9 x 5 cm	Similar to 132-1.	Wideawake Mussle Beds	KH, Uni Kiel
M64/1	134	1	VSR	14.04.2005	6:54	4	49.01	12	23.05	3000	few small pieces	Basaltic glass with plagioclase phenocrysts.		KH, Uni Kiel
M64/1	135	1	VSR	14.04.2005	9:00	4	49.02	12	22.51	3001	max diameter: 7 cm	Two pieces of aphyric basalt lava with 1 cm glass crust.	in addition , the sample contains several glass shards	KH, Uni Kiel
M64/1	136	1	VSR	14.04.2005	11:24	4	48.26	12	21.86	2970	up to 0,5 cm	Aphyric basalt glass + some globigerina.		KH, Uni Kiel
M64/1	137	1	VSR	14.04.2005	13:36	4	48.23	12	21.00	2903	<2 g	Foraminiferous sediment.		KH, Uni Kiel
M64/1	139	1 to 8	GTV	14.04.2005	20:17	4	48.570	12	22.417	2985	ca. 1000 kg	Diverse association of different types of sulfides: individual cpy-rich chimneys, pyrite-marcasite-chimneys, coalesced microchimneys, anhydrite-rich pieces with varying proportions of magnetite+chalcopyrite, cavities lined with euhedral gypsum crystals, friable magnetite-rich samples, minor sphalerite; locally oxidation => hematite bands.	from inactive chimney adjacent M2 site at Turtle Pits; position confirmed by following ROV dive	SP, IFM-GEOMAR
M64/1	141	6	ROV_AC	15.04.2005	?	4	48.56	12	22.41	2985	6 pieces up to 8 x 3 x 4 cm	Pyrite-marcasite crust, chalcopyrite in the interior is typically altered (pigeon color). Redbrown outer surface: Fe-oxihydroxide coating. One piece with central vug (2 x 3 cm) line with pyrrotite + isocubanite (?). Some of the fragments contain 1-3 mm layer of magnetite separating the chalcopyrite and pyrite-marcasite zones.	position of Turtle Pits area	SP, IFM-GEOMAR
M64/1	142	1	VSR	15.04.2005	22:44	4	48.75	12	22.52	3004	up to 2 cm	Several aphyric basalt glass fragments.		KH, Uni Kiel

Sample ID	Information about station										Size	Sample description Rock type	Comments	Sampling record Where is the sample:
	Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.				
M64/1	146	1	ROV_P	16.04.2005	14:08	4	48.88	12	22.93	2973	10 x 16 x 14 cm	Altered, highly plagioclase-phyric basalt, 20 % plagioclase phenocrysts up to 12 mm in diameter. Sample of lava crust. Glass is completely altered (clay-Mn Oxide, Fe Oxihydroxide), abundant biological colonization.	sedimented pillow lava on top of volcanic peak within the axial valley	KH, Uni Kiel
M64/1	146	2	ROV_P	16.04.2005	18:24	4	48.35	12	22.69	3024	largest piece: 6 x 5 x 4 cm; ca. 500 g	Fresh glassy aphyric basalt; large elongate cavities: long axis (>5 cm) parallel to the flow fold axis.	jumbled sheet flow	KH, Uni Kiel
M64/1	146	3	ROV_P	16.04.2005	20:24	4	47.90	12	22.62	3045	15 x 13 x 9 cm	Sulfide knob on inactive chimney. Friable interior with irregular cavities lined by sphalerite and chalcopyrite (crystals <1 mm). Bulk of the piece consists of chalcopyrite-marcasite. Crust: 2 mm black Fe-oxihydroxide.	inactive chimney S of Red Lion hydrothermal field	SP, IFM-GEOMAR
M64/1	146	7	ROV_P	16.04.2005	22:57	4	47.82	12	22.60	3048	12 x 8 x 6 cm	Sphalerite-rich fragment of active smoker. Internal cavity (2 x 1.5 cm) lined by pyrrhotite (+isocubanite?). Crust of Fe-oxihydroxide is extensively coated by white material (sulfur?) and orange-brown globules coated by Fe-oxides.	Location: Shrimp smoker in Red Lion Field	SP, IFM-GEOMAR
M64/1	148	1	VSR	18.04.2005	19:42	8	49.00	13	29.80	2230	ca. 1 g	Small chips of gray, microcrystalline aphyric basalt, trace of glass chips.		KH, Uni Kiel
M64/1	150	1	VSR	18.04.2005	23:27	8	48.01	13	30.30	2211	< 1 g	Small amount of glass particles.		KH, Uni Kiel
M64/1	151	1	VSR	19.04.2005	1:06	8	47.99	13	30.10	2219	up to 3 cm	Basalt		KH, Uni Kiel
M64/1	152	1	VSR	19.04.2005	2:29	8	47.99	13	29.81	2223	up to 1 cm	Several glass pieces.		KH, Uni Kiel
M64/1	153	1	VSR	19.04.2005	3:56	8	47.99	13	29.29	2165	ca. 1 g	Shell fragments (sediment patch).		KH, Uni Kiel
M64/1	155	1	ROV_P	19.04.2005	10:35	8	48.98	13	30.50	2161	10 x 10 x 5 cm; total: ca 2 kg	Glassy basalt from talus breccia, covered by mud, rare <1mm olivine phenocrysts.		KH, Uni Kiel; 1 kg to CF
M64/1	155	2	ROV_P	19.04.2005	11:07	8	48.99	13	30.44	2172	11 x 20 x 15 cm	Microcrystalline basalt, ca. 5% vesicles up to 2 mm in diamter, <1% olivine phenocrysts up to 1 mm, top coated by Mn-Oxide crust, abundant microorganisms.		KH, Uni Kiel
M64/1	155	3	ROV_P	19.04.2005	11:54	8	49.00	13	30.30	2149	22 x 14 x 4 cm	Four cm thick roof of lava lobe. Top surface is glassy (2 mm thick), 5 % vesicles up to 5 mm in the microcrystalline basalt below the glass crust; lower surface with stalagmite texture; rare olivine phenocrysts <1mm.		KH, Uni Kiel
M64/1	155	4	ROV_P	19.04.2005	13:20	8	48.96	13	30.17	2195	18 x 9 x 7 cm	Aphyric basalt, pillow section, microcrystalline with partially palagonitized glass crust (ca. 1 mm); 2 % vesicles up to 2 mm.		KH, Uni Kiel
M64/1	155	5	ROV_P	19.04.2005	14:01	8	48.99	13	30.06	2199	21 x 12 x 10 cm	Altered aphyric basalt with <1% pyroxene and rare plagioclase (<1 mm). Piece consists of two individual lobes showing ductile deformation.		KH, Uni Kiel
M64/1	155	6	ROV_P	19.04.2005	14:33	8	48.99	13	30.04	2190	19 x 8 x 3 cm	Piece of pillow crust with prominent striated top surface texture. Roof (3 cm thick) of partially drained pillow. Glass on both sides (top: 2 to 4 mm; base < 1mm). Partial palagonitization. 1% olivine phenocrysts up to 5 mm.		KH, Uni Kiel
M64/1	155	7	ROV_P	19.04.2005	15:23	8	48.99	13	29.97	2221	largest piece 3 x 3 x 0.3 cm; total ca. 400 g	Abundant aphyric basalt glass chips of pillow crust. Partially palagonitized.		KH, Uni Kiel
M64/1	155	8	ROV_P	19.04.2005	16:59	8	49.04	13	29.85	2218	1.5 x 3 x 2 cm	Single piece of microcrystalline basalt with 1% olivine phenocrysts (up to 1 mm); ca 1% vesicles (up to 2 mm). Glass crust is 1-3 mm thick and locally shows spherulitic textures.		KH, Uni Kiel
M64/1	156	1	VSR	19.04.2005	20:02	8	48.43	13	30.42	2208	up to 1 cm	Basalt glass.		KH, Uni Kiel
M64/1	157	1	VSR	19.04.2005	21:56	8	47.70	13	30.56	2190	up to 5 mm	Basalt glass.		KH, Uni Kiel
M64/1	159	1	ROV_P	20.04.2005	10:25	8	48.18	13	30.12	2204	several small pieces up to 2 cm, ~10 g	Glassy basalt with 1% olivine and plagioclase phenocrysts up to 1 mm, some palagonite.	Pillow lava, contamination by pieces from previous dive?	KH, Uni Kiel
M64/1	159	2	ROV_P	20.04.2005	10:54	8	48.15	13	30.12	2201	8 x 6 x 2 cm3	Basalt with 3 mm glass crust, <1% plagioclase phenocrysts 2% vesicles up to 2 mm, minor Fe staining.	sheet flow	KH, Uni Kiel
M64/1	159	3	ROV_P	20.04.2005	11:28	8	48.06	13	30.12	2198	3 x 7 x 9 cm3	Aphyric glassy basalt; flow fold quenched on both sides, slight palagonitization, microcrystalline groundmass surrounds elongate cavity (long axis >4 cm parallel to fold axis).	jumbled sheet flow	KH, Uni Kiel
M64/1	159	4	ROV_P	20.04.2005	12:16	8	47.99	13	30.12	2201	largest piece 6 x 4 x 3 cm3, total 1 kg	Aphyric glassy basalt, abundant shards <1 to 3 cm in foram./pteropod sand.		KH, Uni Kiel

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	Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.				
M64/1	159	5	ROV_P	20.04.2005	13:12	8	47.96	13	30.16	2186	16 x 10 x 13 cm3	Piece of lava protrusion, plagioclase-phyric glassy basalt, 10 vol.% plagioclase phenocrysts up to 10 mm, surface with striation marks, glass crust partially palagonitized and covered by thin layer of black Mn-oxide.	pillow lava	KH, Uni Kiel
M64/1	159	6	ROV_P	20.04.2005	14:53	8	47.81	13	30.19	2151	4 x 3 x 0.5 cm3 , ca. 200 g	Abundant fragments of aphyric basalt glass shards.	pillow lava	KH, Uni Kiel
M64/1	159	7	ROV_P	20.04.2005	15:42	8	47.75	13	30.21	2201	largest of three pieces: 12 x 15 x 10 cm3	Plagioclase-phyric basalt with 2 mm glass crust, <1% plagioclase up to 1 mm, 3% vesicles up to 2 mm, several zones of shearing up to 1 cm wide oriented parallel to the surface spaced at 2-4 cm intervals. Slight Fe-Oxihydroxide staining.	pillow lava flow	KH, Uni Kiel
M64/1	159	8	ROV_P	20.04.2005	16:40	8	47.76	13	30.21	2202	5 x 3 x 3 cm3	Basalt with 1-2 mm glass crust, slightly palagonitized, few plagioclase phenocrysts (< 1mm), 1 vol. % vesicles up to 1 mm.	sheet flow	KH, Uni Kiel
M64/1	159	9	ROV_P	20.04.2005	17:31	8	47.50	13	30.21	2215	13 x 9 x 8 cm3 in two pieces	Pillow top is glassy (1-2 mm thick), slight palagonitization, <1% plagioclase and olivine, up to 1 mm, lower surface is undulated, solidified lava droplets.	pillow lava on top of jumbled flow #10 and 11	KH, Uni Kiel
M64/1	159	10	ROV_P	20.04.2005	17:56	8	47.46	13	30.18	2219	6 x 4 x 5 cm3	Small lava fold with glassy crust (1-2 mm), plagioclase-phyric basalt, 1% plagioclase up to 1 mm.	jumbled flow	KH, Uni Kiel
M64/1	159	11	ROV_P	20.04.2005	18:01	8	47.46	13	30.18	2219	13 x 14 x 4 cm3	Lava lobe of 4 cm thickness with glassy crust on both sides, abundant palagonitization, 1% plagioclase phenocrysts up to 5 mm, rare olivine.	same location and flow as #10	KH, Uni Kiel; most of the sample for CF
M64/1	160	1	VSR	20.04.2005	21:05	8	46.93	13	30.39	2208	glass fragments up to 2 cm	Basalt glass.		KH, Uni Kiel
M64/1	161	1	VSR	20.04.2005	22:53	8	46.70	13	30.57	2266	glass fragments up to 2 cm	Basalt glass with plagioclase phenocrysts.		KH, Uni Kiel
M64/1	162	1	VSR	21.04.2005	0:34	8	46.22	13	30.64	2273	glass fragments up to 2 cm	Basalt glass with plagioclase phenocrysts.		KH, Uni Kiel
M64/1	163	1	VSR	21.04.2005	2:10	8	45.43	13	30.74	2287	glass fragments up to 2 cm	Basalt glass with plagioclase phenocrysts.		KH, Uni Kiel
M64/1	165	1	VSR	21.04.2005	7:35	8	50.00	13	29.68	2225	glass fragments up to 2 cm	Aphyric basalt glass.		KH, Uni Kiel
M64/1	166	1	VSR	21.04.2005	10:21	8	50.51	13	29.48	2188	ca. 200 g	Chips and fragments of microcrystalline and glassy basalt.		KH, Uni Kiel
M64/1	170	1	VSR	21.04.2005	20:03	9	2.00	13	27.00	2313	<1g	Sediment in vaseline with a few glass particles.		KH, Uni Kiel
M64/1	171	1	VSR	21.04.2005	21:54	9	4.01	13	26.60	2320		Sediment patches.		KH, Uni Kiel
M64/1	175	1	VSR	22.04.2005	5:20	9	7.50	13	25.86	2530	up to 4 cm, total ca. 20 g	Olivine-phyric basalt (1% olivine phenocrysts up to 2 mm), glassy and microcrystalline fragments, moderate palagonitization.		KH, Uni Kiel
M64/1	176	1	VSR	22.04.2005	7:20	9	9.02	13	25.51	2640	up to 2 cm	Basalt glass.		KH, Uni Kiel
M64/1	181	1	VSR	22.04.2005	18:38	9	15.29	13	17.50	2285	up to 3 cm	Altered glass crust with sediment.		KH, Uni Kiel
M64/1	182	1	VSR	22.04.2005	20:22	9	17.02	13	17.02	2072	<0.5 cm	Very few glass chips.		KH, Uni Kiel
M64/1	184	1	VSR	23.04.2005	0:10	9	22.49	13	15.53	1932	<1 g	Few thin rock fragments.		KH, Uni Kiel
M64/1	188	1	ROPV_P	23.04.2005	13:15	9	42.48	13	5.02	1772	14 x 8 x 3 cm3	Piece of aphyric basalt lava. Roof of lava lobe. Glassy crust with abundant palagonitization. Rare olivine phenocrysts (< 1 mm), ca 1% vesicles up to 5 mm. Extensive Mn-oxide coating.		KH, Uni Kiel
M64/1	188	3	ROPV_P	23.04.2005	13:58	9	42.49	13	4.96	1787	14 x 14 x 9 cm3	Piece of aphyric lava lobe. 1 to 2 mm glassy crust with intense palagonitization. Ca. 5 % tubular vesicles (1 mm x 10 mm) concentrated below crust. Extensive Mn-oxide coating and biological colonization.		KH, Uni Kiel
M64/1	188	4	ROPV_P	23.04.2005	15:05	9	42.49	13	4.80	1857	9 x 6 x 4 cm3	Piece of aphyric basalt lava lobe with rare olivine phenocrysts. Glass crust (1 to 3 mm) is heavily palagonitized. Some Fe-oxihydroxide alteration and abundant worm tubes. Vesicles: <1%, < 1mm.		KH, Uni Kiel
M64/1	188	5	ROPV_P	23.04.2005	16:28	9	42.39	13	4.67	1864	5 x 3 x 3 cm3	Two pieces of small lava lobe. Glass crust (1 to 2 mm) is strongly palagonitized. Vesicles: < 1%, < 1 mm.		KH, Uni Kiel
M64/1	188	7	ROPV_P	23.04.2005	17:42	9	42.36	13	4.51	1882	12 x 10 x 7 cm3	Aphyric basalt pillow. Glass crust (1 to 2 mm) is strongly palagonitized. Coated by Mn-oxide and some biological colonization.	Fragment of large pillow.	KH, Uni Kiel; Most of the piece to CF.
M64/1	194	1	ROPV_P	24.04.2005	11:57	9	34.37	13	12.95	1454	10 x 10 x 7 cm3	One piece of aphyric pillow basalt. Vesicles: 3% up to 3 mm. Palagonitized glass crust (1-3 mm); Mn-oxide and Fe-oxihydroxide coating and some biology.		KH, Uni Kiel

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	Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.				
M64/1	194	4	ROPV_P	24.04.2005	13:06	9	34.37	13	12.86	1429	26 x 17 x 12 cm3	Section of aphyric pillow basalt. Vesicles: 5% up to 10 mm. Palagonitized glass crust. Extensive Mn-oxide coating. Biological colonization including trunk of gorgonaria.		KH, Uni Kiel
M64/1	194	6	ROPV_P	24.04.2005	13:40	9	34.37	13	12.77	1436	5 x 5 x 3 cm3	Aphyric basalt. Extensive palagonitization and Mn-oxide coating.		KH, Uni Kiel
M64/1	194	7	ROPV_P	24.04.2005	14:10	9	34.37	13	12.67	1448	9 x 15 x 3 cm3	Roof of lava lobe; Top: wrinkled glass (ca. 5 cm), fresh. Aphyric. Vesicles: 3%, up to 1 mm.		KH, Uni Kiel
M64/1	194	8	ROPV_P	24.04.2005	14:56	9	34.41	13	14.53	1465	34 x 12 x 16 cm3	Section of pillow. Rare olivine phenocrysts (up to 1 mm). Vesicular central part (30% up to 20 mm, locally coalesced). Tubular vesicles (up to 4 cm long) oriented normal to the exterior in the outer 10 cm of the section. Outermost 1-2 cm are vesicle-free. Some glassy patches preserved.		KH, Uni Kiel
M64/1	194	9	ROPV_P	24.04.2005	16:01	9	34.43	13	12.52	1465	7 x 4 x 3 cm3	Three pieces of aphyric basalt with 1 to 3 mm glass crust.		KH, Uni Kiel
M64/1	194	10	ROPV_P	24.04.2005	16:44	9	34.37	13	12.50	1470	13 x 10 x 6 cm3	Vesicular aphyric basalt. Vesicles: 10%, up to 5 mm, locally coalesced. Outer zone (1 cm) is vesicle-free. Glass crust (1-2 mm) is slightly palagonitized.		KH, Uni Kiel
M64/1	194	11	ROPV_P	24.04.2005	17:04	9	34.38	13	12.49	1470	8 x 6 x 5 cm3	Piece of aphyric lava fold with 1 mm glass crust on both sides. Central zone contains 20% vesicles up to 1 cm; abundant tubular vesicles oriented normal to the exterior. Outer 1 cm on both sides are vesicles-free.		KH, Uni Kiel
M64/1	194	12	ROPV_P	24.04.2005	17:48	9	34.38	13	12.34	1460	15 x 10 x 8 cm3	Crust of aphyric lava lobe with wrinkly lower surface. Slightly palagonitized glass crust (1 to 2 mm). Vesicles are tubular, oriented normal to the surface (20%).	Total is about 1 kg,	KH, Uni Kiel; some of the piece to CF.
M64/1	194	13	ROPV_P	24.04.2005	18:20	9	34.38	13	12.34	1468	30 x 23 x 5 cm3	Slab of aphyric sheet flow exposed in collapse pit. Roof of lava tunnel. Top surface is wrinkled on 10 cm scale. Fresh glassy crust with prominent perlite texture. Lower surface with abundant lava droplets, thin-walled bubbles and linear lava stalagmites.		KH, Uni Kiel
M64/1	200	1	ROV_P	25.04.2005	9:57	9	32,99	13	12,92	1469	8 x 14 x 7 cm3	Aphyric pillow basalt. Vesicles: 5% up to 10 mm. Extensive Mn-Oxide coating. Patch of glassy crust, partially palagonitized.		KH, Uni Kiel
M64/1	200	2	ROV_P	25.04.2005	10:48	9	32,96	13	12,80	1523	11 x 11 x 8 cm3	Pillow basalt. Olivine phenocrysts: <1% up to 1 mm. Vesicles: 5%, irregular shapes, up to 10 mm. Extensive Mn-oxide coating, 1 mm palagonitized glass crust.		KH, Uni Kiel
M64/1	200	3	ROV_P	25.04.2005	11:29	9	32,90	13	12,72	1505	22 x 17 x 5 cm3	Piece of lava lobe roof. Aphyric. Top surface shows mm-scale scotch marks (parallel to flow direction) and cm-scale flow folds (long axis normal to flow direction). Fresh glass crust (3 mm). Vesicles: 10% round and tubular. Lower surface: irregular stalagmite texture.		KH, Uni Kiel
M64/1	200	5	ROV_P	25.04.2005	13:01	9	32,93	13	12,51	1494	mud, ca. 300 g	Bright orange Fe-oxihydroxide mud and few small pieces of semi-lithified material.		SP, IFM-GEOMAR; MP
M64/1	200	6	ROV_P	25.04.2005	14:27	9	32,92	13	12,53	1496	13 x 6 x 6 cm3	Piece of 6 cm thick aphyric lava crust. Glass crust (1-2 mm) with minor Mn-oxide coating. Upper layer is vesicle-free; lower 3 cm contain 20% tubular vesicles (up to 3 cm long and 0.5 cm wide) normal to surface with regular spacing.		KH, Uni Kiel
M64/1	200	7	ROV_P	25.04.2005	15:48	9	32,88	13	12,55	1495	6 x 10 x 2 cm3; largest piece	Semi-lithified pieces of Fe-oxihydroxides; crude layering, no apparent Mn-oxides.	Likely low-T hydrothermal product.	SP, IFM-GEOMAR; CF
M64/1	200	12	ROV_P	25.04.2005	19:48	9	32,71	13	12,55	1495	18 x 20 x 10 cm3	Section of aphyric pillow basalt. Vesicles: 10% round to irregular, locally coalesced (up to 2 cm). Glass crust (2 mm) with Mn-oxide coating and biological colonization.		KH, Uni Kiel
M64/1	201	1	VSR	25.04.2005	22:07	9	31,98	13	12,21	1551	few grams	Pelagic sediment.		KH, Uni Kiel
M64/1	202	1	VSR	25.04.2005	23:28	9	32,49	13	12,71	1512	several pieces up to 2 cm in diameter	Basalt glass.		KH, Uni Kiel
M64/1	203	1	VSR	26.04.2005	0:46	9	32,72	13	12,65	1509	ca. 1 g	Basalt glass.		KH, Uni Kiel
M64/1	204	1	VSR	26.04.2005	1:59	9	33,01	13	12,36	1518	several pieces up to 2 cm in diameter	Basalt glass.		KH, Uni Kiel
M64/1	205	1	VSR	26.04.2005	3:13	9	33,5	13	12,53	1497	max diameter: 8 cm	One pillow fragment with glass crust and several glass chips.		KH, Uni Kiel
M64/1	209	1	GTV	26.04.2005	14:53	9	32,86	13	12,52	1511	several pieces; max dimensions 3 x 4 x 0.5 cm	Glassy volcanic crust; partially altered.		KH, Uni Kiel

Sample ID			Information about station								Size	Sample description Rock type	Comments	Sampling record Where is the sample:
Cruise#	Station	Sample	Sampling equipment	Date*	Time*	Lat Deg. S	Lat Min.	Long Deg. W	Long Min.	Water depth				
M64/1	209	2	GTV	26.04.2005	14:53	9	32,86	13	12,52	1511	about 1000 kg of mud with pieces of crust; ca. 1 kg of crusts sampled	Orange to brown semi-lithified Fe-oxihydroxides; numerous pieces of fragile crusts up to 15 x 10 x 1 cm; fine grained.		SP, IFM-GEOMAR; CF
M64/1	210	1	VSR	26.04.2005	16:54	9	33,83	13	12,50	1482	several pieces, max. diameter is 3 cm	Several pieces of aphyric basalt, abundant glass shards.		KH, Uni Kiel
M64/1	211	1	VSR	26.04.2005	18:18	9	34,13	13	12,55	1488	several pieces, max. diameter is 2 cm	Fresh aphyric basalt glass.		KH, Uni Kiel
M64/1	212	1	VSR	26.04.2005	19:31	9	34,55	13	12,40	1413	ca. 0.5 g	Some glass chips.		KH, Uni Kiel
M64/1	213	1	GTV#	27.04.2005	1:58	9	32,83	13	12,55	1513	few grams	Basalt glass chips.		KH, Uni Kiel
M64/1	213	2	GTV#	27.04.2005	1:58	9	32,83	13	12,55	1513	several pieces; max dimensions 7 x 4 x 0.5 cm	Fe-oxihydroxide crusts.		SP, IFM-GEOMAR
M64/1	213	3	GTV#	27.04.2005	1:58	9	32,83	13	12,55	1513	ca. 1 g	Thin (<1 mm) sheets of sulfides.		SP, IFM-GEOMAR
M64/1	214	1	GTV	27.04.2005	3:55	9	32,84	13	12,54	1511	few grams	Fresh aphyric basaltic glass chips.		KH, Uni Kiel
M64/1	214	2	GTV	27.04.2005	3:55	9	32,84	13	12,54	1511	several small pieces	Fe-oxihydroxide crusts.		SP, IFM-GEOMAR
M64/1	214	3	GTV	27.04.2005	3:55	9	32,84	13	12,54	1511	ca. 1 g	Thin sheets (<1 mm) of sulfides.		SP, IFM-GEOMAR

Comments:

#: Sample also contained abundant fauna.

\*: Date and time of sample acquisition.

\*: Sample position accurate within +/- 1 to 2 m relative to the beacon set at 4°48,559'S; 12° 22,413'W