Meteor Berichte 05

Mid-Atlantic Expedition 2005

Cruise No. 64, Leg 2

Longterm study of hydrothermalism and biology at the Logatchev field, Mid-Atlantic Ridge at 14°45'N (revisit 2005; HYDROMAR II)

6 May – 6 June 2005, Fortaleza (Brazil) – Dakar (Senegal)

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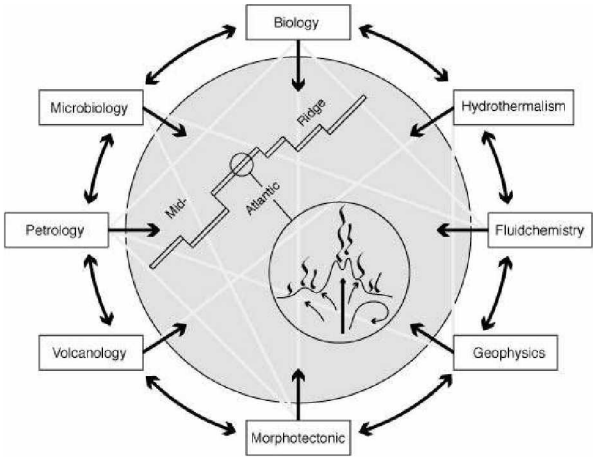

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Content

Summary

The R/V METEOR cruise M64/2 was the second German expedition to the hydrothermal active Logatchev field at 14°45'N which took place from May 6 through June 6, 2005 from Fortaleza/Brasil to Dakar/Senegal.
Further mapping and sampling as well as the first deployment of longterm monitoring stations were accomplished in the Logatchev Hydrothermal Field-1 (LHF-1) at 14°45'N on the Mid-Atlantic Ridge. The main working tools during our cruise were the deep-sea ROV "QUEST", a TV-grab, a TV-sled and a hydrocast. At 14°45.047 N and 44°58'671 W we discovered a 5 m high active black smoker (site "A" after Gebruk et al., 1997) which has been named "Barad-Dûr" after the black tower of Mordor in the bestseller "Lord of the Rings". Based on a video and photographic survey we were able to create a photomosaic of this tower as well as of the smoker complex at the IRINA II site. During a ROV survey northwest of the active QUEST site we found a new diffuse venting site at 14°45.31 N and 44°58.87 W.

Along CTD surveys above the LHF-1 a clearly defined plume in methane concentration (up to 0.3 µmol/L CH4) was identified between 2700 m and 2900 m waterdepth. Strong evidence was found for additional hydrothermal activity approximately 2 nm northwest of LHF-1. High hydrogen concentrations (> 50 nmol/L) together with a layer of increased light transmission at 3030 to 3080 m waterdepth indicate the presence of venting in this area.
During 9 ROV dives we sampled a large variety of sulfides and Fe-oxid-hydoxide crusts. In addition, 7 TV grab stations with serpentinized pyroxenites, Mn-crusts, silicified crusts and atacamites have completed the overall surface sampling in the area of LHF-1 which was a direct continuation of the work begun in 2004 during cruise M60/3. A total of 15 vent fluid samples were obtained with the ROV fluid sampling system. The sampled vent fluids are highly reduced and acidic indicating a low proportion of intermixed seawater. Lowest values obtained for fluid samples were 3.9 for pH and –370 mV for Eh. The highest in-situ temperature measured during this cruise was 350°C at Site "B".
During this cruise, we also contributed to our ongoing studies of geobiological coupling at MAR vents by identifying and characterizing gradients in vent fluids in mussel beds, and collecting mussels along these gradients for analysis of the biomass and activity of the bacterial symbionts. *In-situ* microsensor measurements of O_2, pH, H_2S, T and, for the first time, H_2 were used to investigate the links between the geochemical energy supply from hydrothermal fluids and hydrothermal vent communities. These high-resolution microprofiles allow to determine the variability of hydrothermal fluid emission in space and time and its influences on vent communities.
An ocean bottom tiltmeter (OBT) and an ocean pressure meter (OBP) were deployed in the LHF-1 to monitore tidal loading, micro seismicity and recent tectonic processes over atime period of ≥ 1 year. In addition, we have placed a set of temperature loggers in mussel fields of the QUEST and IRINA II sites monitoring temperature variations in the biological community as possible indicator for changes in their living environment.

2.1 Participants

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2.2 Research Program

(K. S. Lackschewitz, H. Villinger)

The investigations of this cruise are a continuation of the program started between 14°45'N and 15°05'N on the Mid-Atlantic Ridge in 2004 (cruise M60/3). While in the 2004 cruise basic geochemical and biological studies were carried out in the Logatchev hydrothermal field, the emphasis of the 2005 cruise lies on the temporal variability of fluid emanations, fluid temperature and chemistry, microbial activities and associated fauna at selected hydrothermal vent sites. The overall goal of the proposed cruise is to advance the integrated study of the 14°45'N hydrothermal sites further through multi-disciplinary characterization and sampling at several sites. Biological, mineralogical and hydrological samples are to be taken in a well-characterized thermal environment so that the results on the samples can be interpreted in terms of the influence of the important environmental parameter temperature. The cruise is the second in a number of cruises within the 6-year SPP program, dedicated to a long-term study in this area to investigate medium-term variability in the hydrothermally active sites and the related geochemical and biological consequences.

Long-term monitoring of all relevant environmental parameters is essential to assess the temporal variability observed in the biogeochemistry of the hydrothermal field. The parameters are (a) temperature, (b) absolute pressure, (c) mean micro seismicity and (d) local sea floor tilt. We will observe correlation and coupling between hot fluid outflow, hydrothermal activity, tidal loading, micro seismicity and recent tectonic processes with high resolution of amplitudes and time. Additionally, a plume temperature profiler for mapping the extend of the hydrothermal plume, a distributed temperature sensing system for monitoring in particular biological communities at the sea floor, a ROV temperature lance with online data transfer over the ROV communication system up to the ship and a temperature calibration facility for the temperature sensors is provided. Temperature measurements, the use of sensors and the sampling of fluids to determine the chemical composition of the fluids, material fluxes and spatial and temporal gradients give the basic information to characterize the environment in which the ecosystem develops. Three groups are mainly interested in the characterization of free living microorganisms, which are involved in carbon and sulfur cycling in hydrothermal vent areas. Methane consuming communities are studied in hydrothermal fluids, sediments and crusts with a special focus on the process of anaerobic oxidation of methane and in close cooperation with the gas geochemistry group. Another group is predominantly interested in sulfur bacteria and in the influence of temperature on microbial communities, cooperating closely with the groups analyzing sulfur species and isotopes. Environmental genomics are applied to investigate the metabolic capabilities of these microbial communities, thereby focusing on the finding of new genes and unexpected metabolic properties. The development of symbiotic communities (bacteria and host fauna) is directly related to the chemical content and energy of the fluids. However, the pathway of interactions does not only involve influence of the fluids on the development of organism communities, but microorganisms and fauna also change the fluid chemistry due to their uptake and excretion of chemical compounds.

Samples for the biologists are chosen in cooperation with the geochemists measuring the different abiotic parameters. The samples are shared between the different groups, analyzed

in close collaboration and the results will be finally evaluated in the context of all geochemical and microbiological findings with respect to the bio-geo coupling. The aim is to develop an overall model for the temporal and spatial development of the Logatchev hydrothermal ecosystem, which also includes control by general environmental parameters such as water depth and geological conditions.

2.3 Narrative of the cruise

(K.S. Lackschewitz)

The final preparations for cruise M64/2 were completed onboard the R/V METEOR in the harbour of Fortaleza (Brazil) between May 3 and 6. All 22 scientists of Leg M64/2 boarded the ship on May 5. A test of the ROV vehicle in the harbour was successfully carried out at midday on May 6.

The R/V METEOR cleared the port of Fortaleza in the afternoon of May 6 and began her transit to 13°30'N and 45°00'W. The scientists used the five-day transit to set up the laboratories and to test their sensors and water sampling equipment. Scientific work started in the afternoon of May 10 with a reference CTD hydrocast station at 13°30'N/45°00'W for sampling seawater from different waterdepths. Hydrosweep mapping along the ridge axis was carried out during the night. A 90 minute transit to our main working area, the Logatchev hydrothermal field (LHF-1; 14°45.20'N/44°58.80'S), was followed by a CTD hydrocast station to investigate the hydrothermal plume over the LHF-1.

In the morning of May 11 the first ROV station failed shortly after deployment due to communication problems between the ROV and the control container. Therefore, a hydrocast station was carried out SW of LHF-1 to investigate the hydrothermal plume dispersal in the water column. A TV-grab (222GTV) was taken about 300m SW of LHF-1 in order to sample the periphery. The samples comprised of serpentinized ultramafics, partly covered with Mn-crusts, and one rock with atacamite. The night of May 12 was filled with a MAPR (miniatur autonomous plume recorder) string jo-jo (5 MAPP's and 20 temperature loggers) to trace the turbidity anomalies of the hydrothermal plume in the area of LHF-1.4.

On May 12 another attempt of a ROV dive failed again due to communication problems. A TV-grab station taken ca. 50 m southwest of IRINA II sampled ultramafics and Mn crusts. In the afternoon we started our first successful ROV dive (224) during our cruise M64-2. After reaching the seafloor we obtained an acoustic signal from the homer beacon 12 which we set up as a reference station during the cruise M60-3 at the QUEST site. We set up another beacon (Nr. 14; 14°45,199'N/44°58,783'W) and an ocean bottom tilt meter (OBT) ca. 42 m southwest of beacon 12. Fluid samples and temperature measurements were taken at a small active black smoker close to the IRINA-II smoker complex.

We continued our geological program with a TV-sled track from the NE to the SW over the LHF-1 in order to find hydrothermal precipitates and map the distribution of ultramafics in this area. Another hydrocast station should further map the distribution of the hydrothermal plume in the water column, whereas a stationary MAPR string over this area should map the temporal variations of the proximal hydrothermal plume.

During May 13 a ROV deployment was not possible due to a high sea swell.

The night to the May 14 was filled with two TV-grab stations and one hydrocast station. 229 GTV was taken ca. 50 m west of ANNA LOUISE. The samples comprised of weakly indurated to higher indurated brownish sediment, dark grayish sediment with fine dispersed pyrite crystals, and several Mn-crusts . At station 230 GTV south of „A“ the samples consist of altered coarse-grained to pegmatoid orthopyroxenites. The hydrocast station (231CTD) sampled the hydrothermal plume ca. 200 m northwest of the QUEST site.
During dive 232ROV on May 14 biological and fluid samples were taken from a mussel field at the southern rim of the IRINA II compex. A special objective was a mussel transplant experiment. In this experiment we are investigating how the removal of the mussels from the vent fluids will influence them and their symbiotic bacteria. Before collecting the mussels, insitu measurements of several physico-chemical parameters were taken (oxygen, temperature, sulfide, hydrogen, pH) with a profiler module. In addition, fluid samples were taken.
Plume mapping with the CTD was carried out during the night of May 14 to 15. The northernmost CTD station detected three turbidity anomalies at 2700 m, 2900 m and 3050 m ca. 1.5 km NNW of the LHF-1 suggesting at least one other unknown hydrothermal source. A TV-grab (station 239) was taken ca. 250 m northeast of IRINA-II in order to sample the periphery of the LHF-1. Beside much sediment, crusts covered with atacamite and several pieces of talc were detected. On the sediment surface we found several mussel shells of *Bathymodyolus* and *Phymorhynchus*.

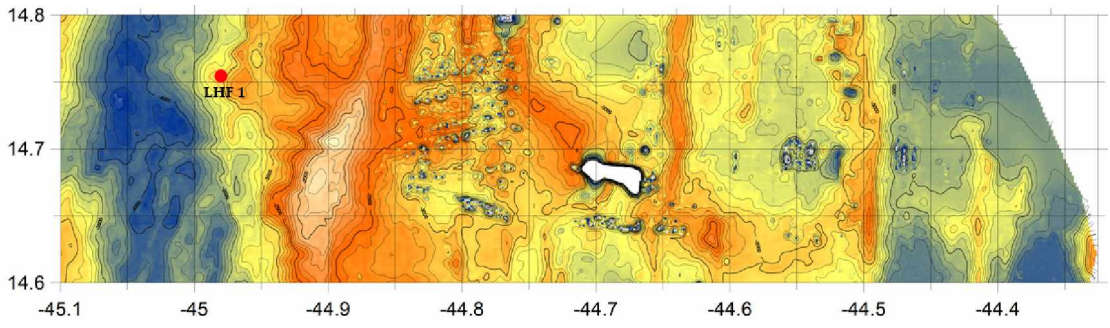


Fig. 2.1: Bathymetric map of the working area produced with Hydrosweep during the cruise M64/2. The location of the Logachev-1 hydrothermal field is indicated by the red dot.

Hydrosweep mapping along 5 profiles was carried out during the night of May 16 to 17. The objective was to map the upper ridge flank east of the Logatchev field (Fig. 2.1).
During dive 244ROV on May 17 the OBT was set up on a plain place together with beacon 14 to the SW of IRINA II. In the following we have continued the mussel transplant experiments of 232ROV by taking 5 nets with mussels and puting them in the inactive area of the OBT. Temperature measurements in the mussel field produced readings ranging between 5 and 50°C. Four hydrocast stations (stations 245 to 248) were carried out in the N of LHF-1. The objective of these stations was to investigate the distribution of the turbidity anomalies in 2700 m, 2900 m and 3050 m.
On May 18 station 249ROV was reserved for fluid sampling of black smokers at ANNA LOUISE and IRINA I. At both sites temperature measurements with an 8-channel temperature probe produced values of 205°C and 188°C, respectively. A TV-grab (st 250)

between IRINA II and site „B“ sampled a thick sediment unit showing colors from yellowish brown, reddish brown and green. A temperature measurement in the sediment yielded still 43°C. In addition, samples consist of silicified crusts and highly altered peridotites and pyroxenites.

The dive 252ROV on May 19 aimed at detailed mapping the southernmost area of LHF-1 including site „A“ which was not discovered during M60/3. After the installation of beacon 11 at IRINA I site we started our mapping profiles south of ANNA LOUISE. On the second profile we found a 5m high active black smoker which is related to site „A“, first described by Gebruk et al. (1997). We named this smoker „Barad-Dûr“ after the black tower of Mordor in the book „Lord of the Rings“. We sampled several sulfide fragments from the underlying mound of Barar-Dûr and another rock sample from the IRINA I site.

Four hydrocast station stations (253-256) during the night from May 19 to 20 mapped and sampled the plume in 2700 to 2800 m ca. 600 m to the northwest of LHF-1.

During the day of May 20 the dive ROV 257 placed 10 temperature loggers in the mussel field at IRINA II for longterm monitoring. Another main target of this dive was to sample fluids, sulfides and bacteria mats at site „B“. The onboard analyses of the fluids have shown a pH of 3.9. The following night two TV grab stations east and northeast of QUEST and a hydrocast station to the NNW of LHF-1 were carried out. The first TV grab (st. 258) sampled a few shells of the hydrothermal mussel species *Calyptogena* and several small peridotite pieces. The second TV-grab (st. 259) was empty. The hydrocast (st. 260) sampled 11 water samples from different water depth ca. 1.5 km NNW from LHF-1.

Station 261ROV on May 21 concentrated on fluid sampling at Site „A“ and IRINA. In addition, sulfides were sampled at both sites. During the night Hydrosweep mapping was continued on the upper ridge flank to the east.

During dive 263ROV on May 22 a special objective was a sampling program in the area of the Russian marker ANYA. We sampled two push cores for bacterial studies and mussels with a net. In addition, we set up a beacon (11) to provide a precise site location because the original position according to Gebruk et al. (2000) appeared to be northwest of IRINA II.

We continued our program with two hydrocast stations west of LHF-1. Both stations showed no turbidity anomalies, but water samples between 2700-2800 m have still minor methan anomalies.

During ROV station 266 on May 23 fluid parameters were measured directly above five places in a diffuse venting mussel field of IRINA II by the profiler module. After the investigation of this site we picked up beacon 11 near the marker „ANJA“ and placed it 10 m east of site „B“. In the following, we took fluid samples at a black smoker which is close to the sampled smoker of 257ROV. Temperature measurements at both sites show values of 350°C and 300°C..

Four hydrocast stations (st. 267-270) ca. 0.5-1 sm south and southeast of LHF-1 did not show a turbidity signal of the plume. However, we have still identified the plume by a slight increase of CH_4 in water samples between 2700-2800 m

On May 24 we started with a deployment of a 25 m longterm temperature mooring from the ship (st. 271). During the following ROV station 272 we repositioned this mooring in the region between IRINA I and ANNA LOUISE. Another target was the precise horizontal placement (angle of < 2°) of the OBT at beacon 14. In addition, we placed two push cores in

the mussel field of IRINA II for microbial experiments and we took some samples from an inactive smoker ENE of IRINA II.
Another four hydrocast stations (st. 273-276) have indicated that the eastern ridge flank acts as a boundary for the distribution of hydrothermal plume to the east and northeast.
During dive 277ROV on May 25 we placed again the profiler module in the diffuse venting mussel field at IRINA II. Temperature measurements showed values up to 140°C. In addition, a baited trap was deployed on the mussel bed close to the chimney complex. Detailed video images were recorded along two horizontal profiles of the eastern part of the chimney complex for constructing a photomosaic of this whole structure. Diffusely venting fluids were sampled at the chimney complex close to the area which was already sampled during M60-3 (st. 38ROV). Hydrothermal fauna were collected here also. At the end of the dive we mapped the area east of IRINA II along two profiles.
A TV-sled track (st. 278) was carried out 2 sm north of LHF-1 in order to find indications of an active vent field creating the hydrothermal plume in 3050 m water depth. Due to an electric failure this station was aborted shortly after the first profile. In following two hydrocast station were carried out above the QUEST vent site and ca. 3 sm NW of LHF-1.
The main target of dive 281ROV was a sampling program at the QUEST site. First we placed a benthic chamber on a mussel bed at IRINA II to measure H_2 and S^{2-} for several hours. At QUEST site we sampled fluids and a net of hydrothermal fauna at a diffuse venting mussel bed. At this site we placed also 9 longterm temperature monitoring loggers. In addition, we took fluid samples, temperatures and sulfide samples from a hot venting black smoker. During the following night Hydrosweep mapping was continued on the upper eastern ridge flank.
At dive 283ROV on May 27 we continued our work at QUEST site. We deployed two 8-channel temperature loggers in the main mussel bed and sampled diffuse fluids with 3 Niskin bottles. A camera survey over the mussel bed was made to produce a photomosaic. Next we placed the OPT on more stable ground and took the last net for the mussel bed experiment. In the following we finished our sampling program in IRINA II taking another fluid samples, temperatures at two vents and a net with shrimps. At the end of the dive we picked up the beacon 13 and the baited trap. The night to May 28 was filled with another TV-sled station (st. 284) which investigated the area northwest of LHF-1 along several profiles searching unknown hydrothermal sites.
After this TV-sled track our last ROV station (285ROV) explored and mapped the area northwest of QUEST site in order to find an unknown vent site. After several profiles we found a new diffuse venting site with several highly altered crusts ca. 150 m northwest of QUEST site.
Station work of cruise M64/2 was finished after this station and R/V Meteor started her transit to Dakar. R/V Meteor arrived the port of Dakar on June 4, at 06:00 am. All containers were brought to the pier and loaded there by the scientific and technical crew. The scientists of cruise M64/2 disembarked until the early evening of June 6, 2005.

2.4 Preliminary Results

2.4.1 Detailed geological studies of the Logatchev-1 hydrothermal field

(K.S. Lackschewitz, N. Augustin)

The geological setting and structure of the Logatchev-1 hydrothermal field (LHF-1), situated on a small plateau on the eastern flank of the inner rift valley at 14°45' N, has been described by several workers (e.g., Krasnov et al. 1995; Gebruk et al., 1997). Extensive bathymetric and video mapping of the LHF during the first RV Meteor cruise M60/3 have revealed the main factors of its tectonic control (Kuhn et al., 2004). Detailed sampling has allowed study of the interrelationship of geological, geochemical and biological processes of an ultramafic-hosted hydrothermal system.

The present detailed work carried out during the second RV Meteor cruise M64/2 resulted in a further mapping and sampling as well as the first deployments of long term monitoring stations (Fig. 2.2).

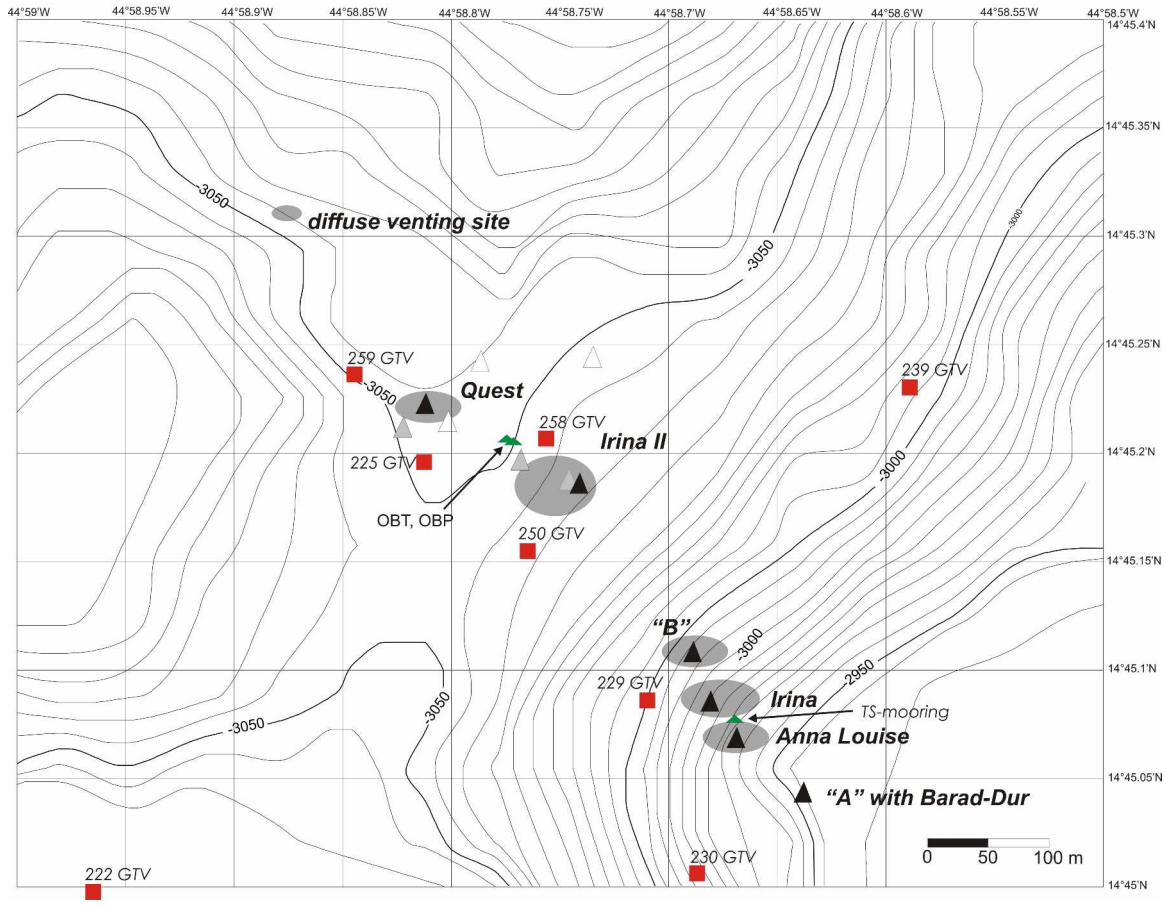


Fig. 2.2: Logatchev-1 hydrothermal field with long-term monitoring and TV-Grab stations (GTV) carried out during M64/2. A new diffuse venting-site is located NW of QUEST.

The LHF-1 extends at least 800 m in a NW-SE and probably more than 400 m in a SW-NE direction as previously described by Kuhn et al. (2004). At the southeastern end of LHF-1 we discovered the 5m high black smoker of Site" A" which was previously identified by Gebruk et

al. (1997). We gave this smoker the name „Barad-Dûr“ after the black tower of Mordor in the book „Lord of the Rings“. Barad-Dûr is sitting on a 3 m-high mound of chimney talus. There were no mussel beds at this site, and hydrothermal fauna was restricted to shrimps and crabs on the upper part of the smoker. A photographic and video survey obtained by the ROV proved to be adequate for preparing a photomosaic of the structure (Fig. 2.3).

Hydrothermal fluids were sampled here for the first time. The marker „MB“ indicates this site as a reference fluid sampling station (see Appendix 2). In addition, several chimney fragments were sampled at the base of Barad-Dûr. The area northwest of site „A“ is characterised by the three hydrothermal sites ANNA LOUISE, IRINA und „B“ consisting of smoking craters. At ANNA LOUISE black smoke was intensely venting from the chimneys on the crater rim and from holes in the ground within the crater. Strong bottom currents resulted in almost horizontal plume dispersal to the south. Therefore, the so-called „Candelabrum“ chimney on the southern rim of the crater (Kuhn et al., 2004) was hidden from view during most of our observations. A 25 m-long temperature sensor mooring, which we have set up between ANNA LOUISE and IRINA, should measure the temperature variations of the plume dispersal over several months. Hot fluids and chimney fragments were sampled from a black smoker on the northern crater rim of ANNA LOUISE. Other fluid and rock samples were taken also at IRINA and „B“. We deposited a marker „MA“ at the sampled smoker of site „B“ and a marker „MD“ at the sampled smoker of site IRINA. Temperature measurements of the fluids have shown values of 205°C for ANNA LOUISE, 177°C for IRINA (at marker „MD“) and 350°C for site „B“ (at marker „MA“). Another small smoker at site „B“ has revealed a temperature of 300°C.

Fig. 2.3: Photomosaic of Barad-Dûr (Site A).

The largest site in the LHF-1 is IRINA II which was one of main targets of our biological studies. IRINA II consists of a mound with steep slopes rising about 15 m above the surrounding seafloor. A chimney complex, ca. 2 m high, marks the top of the mound. Based

on a video and photographic survey we were able to create a photomosaic of this smoker complex (Fig. 2.4). A sonar scan shows clearly the different chimney structures.

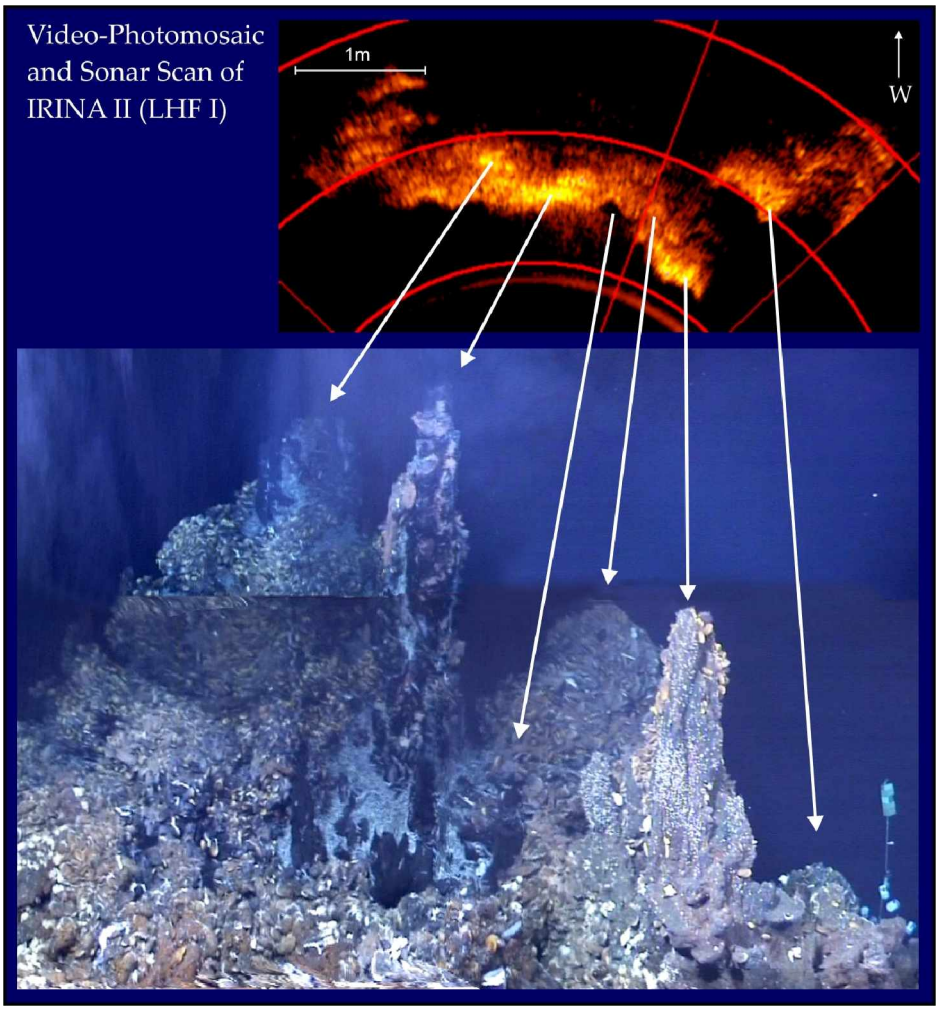


Fig. 2.4: Photomosaic and Sonar Scan of the eastern IRINA II chimney complex.

Most of the chimneys are densely overgrown with mussels (*Bathymodiolus*). Shrimps (*Rimicaris exoculata*) are highly concentrated over low-temperature fluids along the sides of the chimneys. The chimney complex is surrounded by densely populated mussel beds and by small active and inactive chimneys. Temperature measurements at a small active chimney on the northwestern side yielded values of up to 170°C, whereas a small chimney in between the complex revealed values of up to 225°C. These chimneys were also sampled for hot fluids. The mussel beds around the chimney complex are characterized by diffuse venting fluids. The temperatures of these emanating fluids, which were measured by a profiler module have shown a temperature range of 2.6° to 8°C (see chapter 2.4.10). We placed ten temperature loggers on a mussel bed at the southeastern side of the smoker complex to monitore the diffuse venting fluids for several months. A special objective was a mussel transplant experiment. In this experiment we are investigating how the removal of the mussels from the vent fluids will influence them and their symbiotic bacteria (see chapter 2.4.9).

As already described by Kuhn et al. (2004) the area around the Russian marker ANJA is located at a slope approximately 30 m northwest of the IRINA II-complex. This marker identifies a site called ANJA'S GARDEN in Gebruk et al. (2000) and these authors described that it occurs a 100 m northwest of IRINA-II. Based on our precise DVL navigation, we assume that the Gebruk et al. (2000) description of the ANJA marker location is incorrect. At the ANJA marker we found clusters of living and dead *Bathymodiolus* shells together with shimmering water. Visual observations during our dives in this area indicated that vesicomyid clams might be present. However, a ROV sample taken from the area of an old marker „C", which is located close to the ANJA marker, revealed only *Bathymodiolus* shells.
Just north of the IRINA II mound we placed an Ocean Bottom Tiltmeter (OBT) and an Ocean Bottom Pressuremeter (OBP) as longterm monitoring stations (see chapter 2.4.5) close to the new LHF-1 reference beacon 14 (14°45.199'N / 44°58.783'W).
The QUEST site, which was newly discovered during our first Meteor cruise M60/3 (Kuhn et al., 2004), is situated ca. 130 m WNW of the chimney complex of IRINA II. It is characterized by a smoking crater surrounded by several small active chimneys. Fluids and chimney fragments were sampled from a small black smoker on the northeastern side of the crater indicated by the marker „MC". We have measured here fluid temperatures up to 285°C. Elongated clusters of mussels occur southeast of the smoking crater. ROV samples revealed that the mussels consists of abundant juvenile forms which is in contrast to the high abundance of adult forms at IRINA II. A temperature logger (#3), which we deployed here on the M60/3 cruise, showed values of up to 12°C. Therefore, we placed here nine 1-channel temperature loggers and two 8-channel temperature loggers for longterm measurements.
Mapping the area north of QUEST site with the ROV revealed sediments with ripple marks intercalated by several ultramafic outcrops. At ca. 150 m northwest of the QUEST site we found a diffuse venting site with highly altered ultramafics confirming a larger extent of LHF-1 similar to the observation made by Kuhn et al. (2004).

2.4.2 ROV deployments

(G. Ruhland and ROV-Team)

The remotely operated deep diving robot QUEST is an electrical 4000 m rated, work class ROV, which is operated by MARUM, University of Bremen, since May 2003. The vehicle has been manufactured by Schilling Robotics, Davis, USA. The total QUEST system weights 45 tons (including the vehicle, control van, workshop van, winch, 5000 m umbilical, launch-and-recovery-frame, and two transportation vans, all 20-feet-size). The 5000 m of 17.6mm NSW umbilical is stored and managed by an electrical MacArtney Cormac winch. No hydraulic connections have to be installed during mobilisation.
QUEST's first use within SPP1144 took place during Rv METEOR leg M60/3 in January 2004. The leg M64/2 is the second task of QUEST in the Logachev Hydrothermal Vent Field. The technical innovations of the ROV provided a flexible and highly adaptable platform for scientific sampling and observation tasks and therefore played a major role to the scientific success aboard RV METEOR. Since the previous leg new features have been additionally installed including the highly integrated USBL positioning system, based on the French

IXSEA-GAPS inertial Navigation and Positioning system. However, due to a malfunction of the GAPS system Inertial Navigation and Positioning could be used only very limited. In addition, QUEST uses a Doppler velocity log (DVL) to perform StationKeep or Displacement mode, automatically controlled 3D positioning, and other auto control functions. Navigational purposes were supported by an array of Sonardyne HF beacons set in the vent field. An additional frame installed in the ship's A-frame enables much smoother and safe handling of the ROV during launch and recovery.

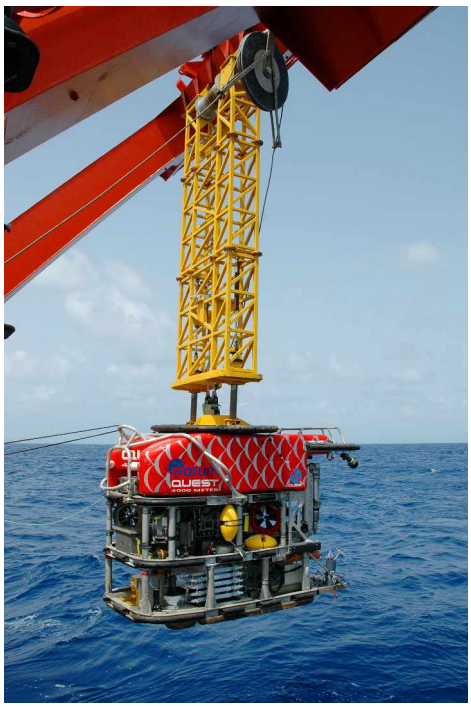


Fig. 2.5: Launching of the ROV with an additional frame at the aft (Photo: D. Garbe-Schönberg).

The QUEST system can be precisely controlled with its 60 kW electric propulsion system and is operated as free-flying vehicle. No tether management system (TMS) has to be operated at the same time the ROV is working. The collection of biological and geological samples and the pumping of fluids could be done with two installed robotic arms. While the RIGMASTER manipulator can lift and handle devices or samples up to 250 kg, the ORION manipulator is used to handle probes or work on delicate tasks.

A set of video and still picture cameras together with a 2.4 kW light suite provides possibilities for video mapping and photo mosaicing. Therefore two green lasers which are installed parallel to each other can be used as size relation. Due to a water leak the Insite Pacific ATLAS camera could be used on the first four dives only.

Besides cameras and manipulators, the scientific equipment installed during leg M64/2 constisted of a CTD with turbidity and high-temperature sensors, which could be used only on three dives due to a water intrusion in the housing. A set of niskin bottles, a 675 kHz scanning sonar, a sample drawbox and several different sampling tools such as "hand" nets and grabbing devices complete the installed equipment.

The scientific data base system used at MARUM feeds all ROV- and ship-based science and logging channels into an adapted real-time database system (DAVIS-ROV). The QUEST control system provides transparent access to all RS-232 data and video channels. During operation data and video has be distributed by the real-time database via the ship's network system in different laboratories and supply the scientists with data from their own devices. Dive summaries containing all data of interest including video and digital still photographs were compiled after each dive. Using the database's export capabilities in combination with the software product "ADELIE" developed at IFREMER, GIS based plots, data graphs and divetrack maps containing time and position-referenced scientific data, video and images were available shortly after or even during the dives.
Post-cruise data archival will be hosted by the information system PANGAEA (www.pangaea.de) at the World Data Center for Marine Environmental Sciences (WDC-MARE), which is operated on a long-term base by MARUM, University of Bremen, and the Foundation Alfred Wegener Institute for Polar and Marine Research, Bremerhaven (AWI).
During leg M64/2 QUEST could be successfully deployed 15 times while 14 of these dives reached the bottom. Launch and recovery has been done at sea states up to 2.5 m and winds of up to 6 bft.. Total bottom time of 110 hours could be achieved at depths of 2950 to 3050m. The planned scientific program could be finished completely during the leg. Beneath scientific sampling and photo mosaicing the current working map could be improved and completed in some parts. Two scientific devices, an ocean bottom tiltmeter (OBT) and an ocean bottom pressure sensor (OBP) had been transported with the ROV to the bottom and installed during the dives. 24 temperature loggers for a yearly monitoring program were also distributed in mussel fields. A profiler frame and a benthic chamber had been successfully transported and set with the ROV several times for a daily monitoring.
During all operations, the crew of RV METEOR provided a very successful and smooth handling on deck, excellent navigation and professional technical support to fulfill the scientific tasks required.

2.4.3 OFOS deployments

(N. Augustin, H.-H. Gennerich, K.S. Lackschewitz, H. Marbler, T. Pape, S. Weber, G. Schroll)

A total of 3 TV-sled stations were carried out in the vicinity of LHF-1. The objectives of the OFOS (Ocean Floor Observation System) stations were to find signs of unknown hydrothermal activity.
The IFM-GEOMAR TV-sled was equipped with a BENTHOS photo camera and flash, a SONY digital camcorder and a FSI 3'' memory CTD probe. During our first OFOS-station 226 we have mapped a NW-SE profile between 14°45.4'N / 44°58.35'W and 14°44.85'N / 44°59.1' W crossing site „B" of LHF-1 (Fig. 2.6). The beginning of the profile is characterized by a talus field followed by sediments, where we found four temperature anomalies with an increase of 0.03°C. One of this anomalies is close to 239GTV-station showing a temperature of the sampled sediments of 43°C onboard. When we crossed site „B" no sign of hydothermal activity was visible. However, we have measured a temperature anomaly of

0.06°C. The area southeast of LHF-1 is characterized by sediments, some talus and an ultramafic outcrop showing a temperature anomaly of 0.025°C.

Station 278OFOS was carried out to investigate observations during M64-2 stations 238CTD; 253CTD and 273CTD, where physico-chemical parameters in the water column suggested a yet undiscovered fluid source different from the known black smokers of the LHF. The OFOS was equipped with one MTL (Miniature Temperature Logger; see chapter 2.4.5) and one MAPR (Miniature Autonomous Plume Recorder; see chapter 2.4.6.2). Due to cable problems station 278OFOS was interrupted early after 1.5 hrs.
Consequently the area between LHF and the water chemical anomaly in it's northwest was the target of the next OFOS survey, station 284OFOS. This time OFOS, bottom control weight and deep-sea cable were equipped with a dense array of 5 MAPRs, 20 MTLs and 1 CTD between the seafloor and up to 100 m above it, with singular extra sensors in 125 m and 170 m height.
Same as station 226OFOS, also stations 278OFOS and 284OFOS did not show any hints to hydrothermal activities by visual observations. The CTD results of these stations are presented and discussed in chapter 2.4.6.2.

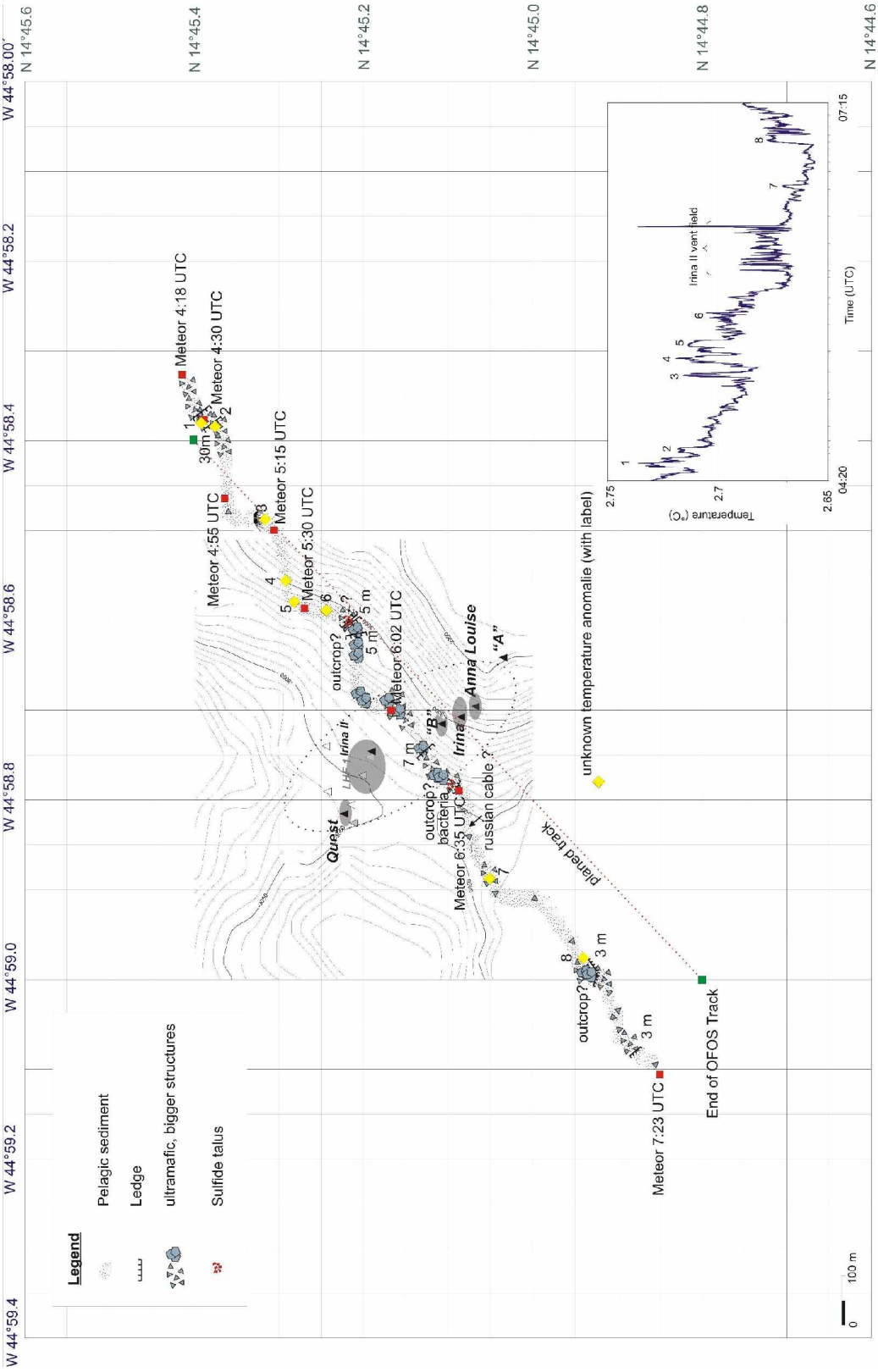


Fig. 2.6: Track of 226OFOS in the vicinity of the active Logatchev-1 hydrothermal field. Insert: Water temperature versus time-diagram of OFOS station 226 showing several distinct temperature anomalies between 0.025 and 0.06°C.

2.4.4 Description of rocks and hydrothermal precipitates

(N. Augustin, H. Strauss)

During cruise M64/2 a total of 14 ROV dives and 8 TV-grab stations recovered geological samples from the seafloor. Information on all sampling stations is given in Table 2.1. A more detailed description of the individual samples is provided in Appendices 4 and 5.

Tab. 2.1: List of geological samples with geographical positions of individual stations.

Lat	Long	Station	Sample types
14°44.99´N	44°58.97´W	222 GTV	serpentinized pyroxenites
14°45.19´N	44°58.82´W	225 GTV	serpentinized pyroxenites, Mn-crusts
14°45.08´N	44°58.72`W	229 GTV	silicified crusts, consolidated sediments, sulfidic muds
14°45.01´N	44°58.68´W	230 GTV	Mn-coated pyroxenites, weakly weathered
14°45.23´N	44°58.58´W	239 GTV	atacamite and silicified crusts
14°45.18'N	44°58.73'W	244 ROV	altered sulfide breccia
14°45.16´N	44°58.77´W	250 GTV	strongly altered peridotites and pyroxenites, quartz-veins
14°45.04'N	44°58.63'W	252 ROV	sulfides chimney-pieces
14°45.12'N	44°58.70'W	257 ROV	Fe-oxide-hydroxide crusts, sulfides
14°45.21´N	44°58.76´W	258 GTV	some Mn-Coated serpentinite pebbles
14°45.24´N	44°58.84´W	259 GTV	GTV empty
14°45.06'N	44°58.64'W	261 ROV	sulfide chimney
14°45,10'N	44°58,67'W	266 ROV	sulfides
14°45.20'N	44°58.74'W	272 ROV	iron-oxide and -hydroxide crusts
14°45.20'N	44°58.74'W	277 ROV	sulfides
14°45.21'N	44°58.81'W	281 ROV	sulfides
14°45,32'N,	44°58,84'W	285 ROV	Fe-oxide, -hydroxide crusts and mud

In general, serpentinized peridotites represent the host rocks of the Logatchev field. Remarkable are samples of coarse grained orthopyroxenites, which are interpreted as magmatic cumulates from the crust/mantle transition zone. Apart from these host rocks, a large variety of hydrothermal samples were collected, confirming the observations made in 2004 during Meteor cruise M60/3. Samples include pieces of active and inactive chimneys, massive sulfides, silicified breccias and crusts, hydrothermal sediments, abundant secondary Cu-sulfides, hematite impregnated serpentinites, abundant Fe-Mn-oxyhydroxides as well as atacamite and Mn-oxides.

Several TV grabs (222GTV, 225GTV, 239GTV, 250GTV and 258GTV) recovered variably altered serpentinized pyroxenites (Fig. 2.7), some of which were coated with a thin Mn-oxide layer. Of these, 250GTV recovered strongly altered peridotites and pyroxenites (a 25cm thick layer). In situ temperatures measured in the unconsolidated material onboard yielded

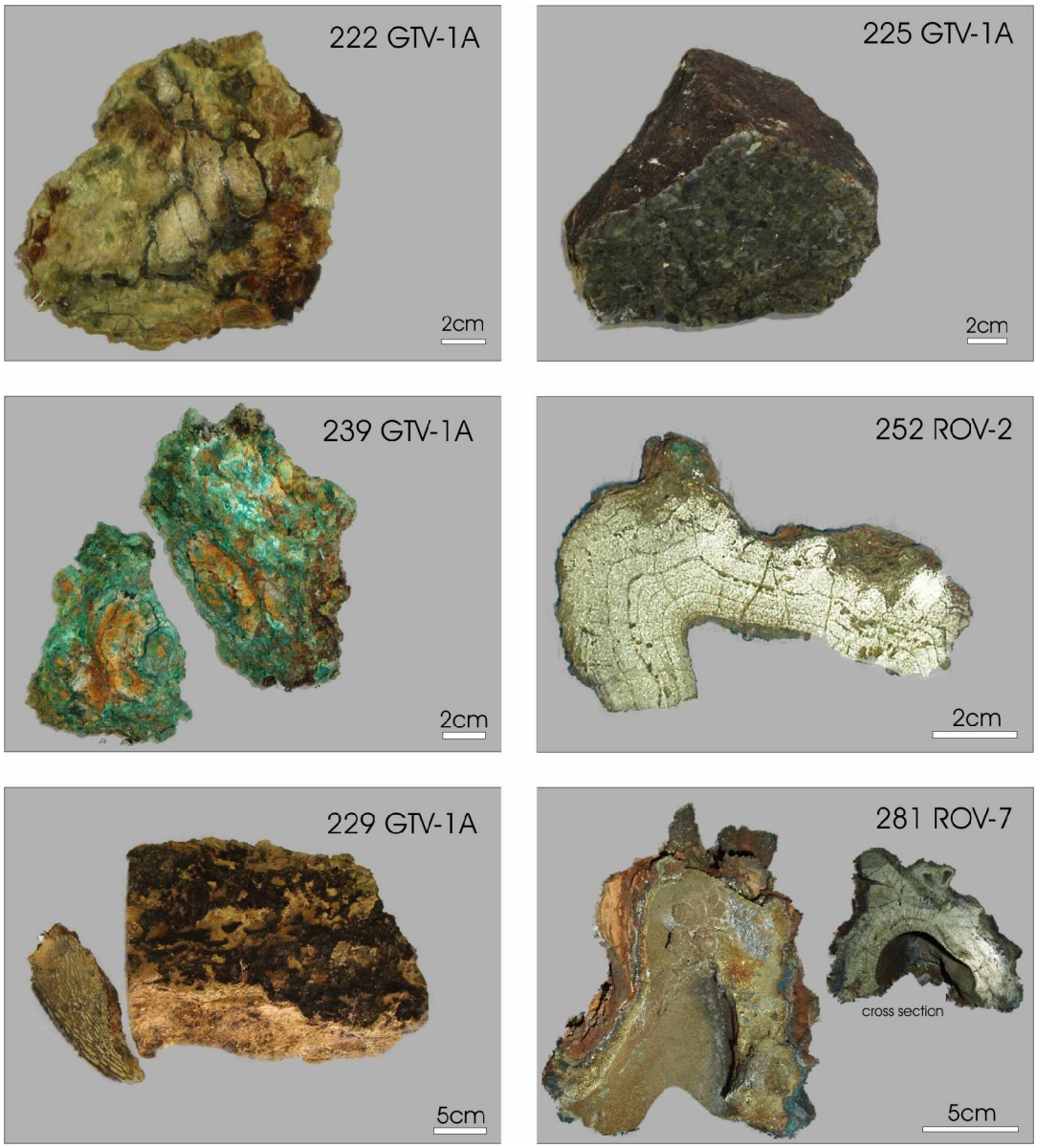


Fig. 2.7: Geological samples recovered during GTV and ROV stations: 222GTV-1A: altered serpentinized pyroxenite; 225GTV-1A: serpentinzed pyroxenite; 239GTV-1A: atacamite crust; 252ROV-2: chimney piece, collected at IRINA I, composed of layers of chalcopyrite; 229GTV-1A: reddish silicified crust with dark brown Mn-oxide coating; 281ROV-7: chimney piece, collected at QUEST site, composed of chalcopyrite with Cu-sulphide rich outer layers

temperatures up to 43°C. This shows that hot fluids circulate beneath the sediment without necessarily venting at the seafloor. 239GTV recovered similar material (this time a 10cm thin and cold layer), with thick atacamite-crusts, hematite impregnated serpentinites, talc and serpentine-breeze. This suggests the presence of an old inactive fluid-pathway. 258GTV contained reddish pelagic sediment, some Mn-coated serpentinite pebbles and empty *Calyptogena* shells**.** 259GTV grabbed a large boulder, was opened again, and returned empty.

Geological sampling during the various ROV dives recovered mainly sulphide samples, either from active or inactive chimneys and/or sulphide talus samples. Most massive sulphide

pieces were composed of chalcopyrite, sometimes displaying a distinctive layering. Other samples comprise more porous chalcopyrite rich interior portions and clearly layered parts towards the outer rim. Occasionally, different fluid conduits could be recognized. The outer rim of all sulphide pieces was generally covered with a thin Fe-oxide coating. 252ROV recovered a large number of pieces which, apart from chalcopyrite as major sulphide, contain abundant colourful copper-rich sulphide minerals (Fig. 2.7). During 261ROV, a fresh sulphide piece comprising largely chalcopyrite was collected from the Barad-Dur chimney at Site A. Further chimney pieces, composed mainly of chalcopyrite and showing individual orifices (Fig. 2.7), were recovered from IRINA II (277ROV) and the QUEST Site (281ROV**)**.

2.4.5 Environmental parameters and longterm monitoring

(M. Fabian, H.-H. Gennerich)

Deployment of long term monitoring instruments

The ocean bottom tiltmeter (OBT) is a platform tiltmeter with two perpendicular axis, X, Y (Fig. 2.8). It has also a high performance MEMS (Micro-Electro-Mechanical-System) accelerometer whose axis is aligned parallel to the OBTs vertical axis and measures total gravity g. The photo shows the OBT in the laboratory of RV Meteor. The OBT uses a biaxial bubble tilt sensor of type Applied Geomechanics Inc. 756. The single-axis accelerometer is of type Kistler Servo K-Beam 8330A2.5 .

The OBT will record local sea floor tilt caused by e.g. tectonics, tidal loading, changes in hydrothermal and deeper magma-plume activity and soil movements like landslides with 1 micro radiant resolution and 6 second sampling interval. Acceleration caused by e.g. micro seismicity, earthquakes or tremors will be measured with 10^{-5}m/s^2 resolution at 0.75 seconds sampling rate. The aluminium frame consists of a rectangular triangle base plate with a tripod and a frame for handling. The larger titanium pressure tube houses batteries, data logger and electronics. The smaller aluminium tube is fixed to the base plate and contains the sensors. The OBT has a deep sea spirit level for levelling the instrument. A good coupling of the instrument to the ground is necessary.

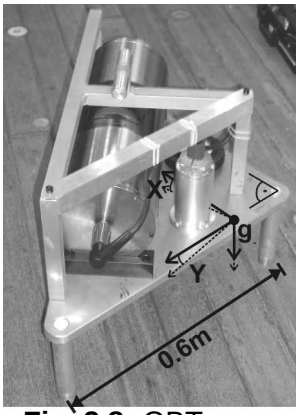


Fig. 2.8: OBT

The OBT was deployed (14°,45.201'N, 44°,58.784'W, 3053m depth; see Fig. 2.9) in the LHF south east of "QUEST" site and west of site "IRINA II" (see Appendix 1). For navigation purposes and to facilitate revisiting an acoustic beacon (No. 14) was placed at this station (see chapter 2.4.1). The OBT was installed on the hilltop of a rock pile by firmly and carefully pressing and moving the legs of the instrument. Orientation of the +Y-axis with respect to the directions of the compass is 295°±3°. The place of the OBT is apart vent sites that measurements are not influenced by hot fluids.

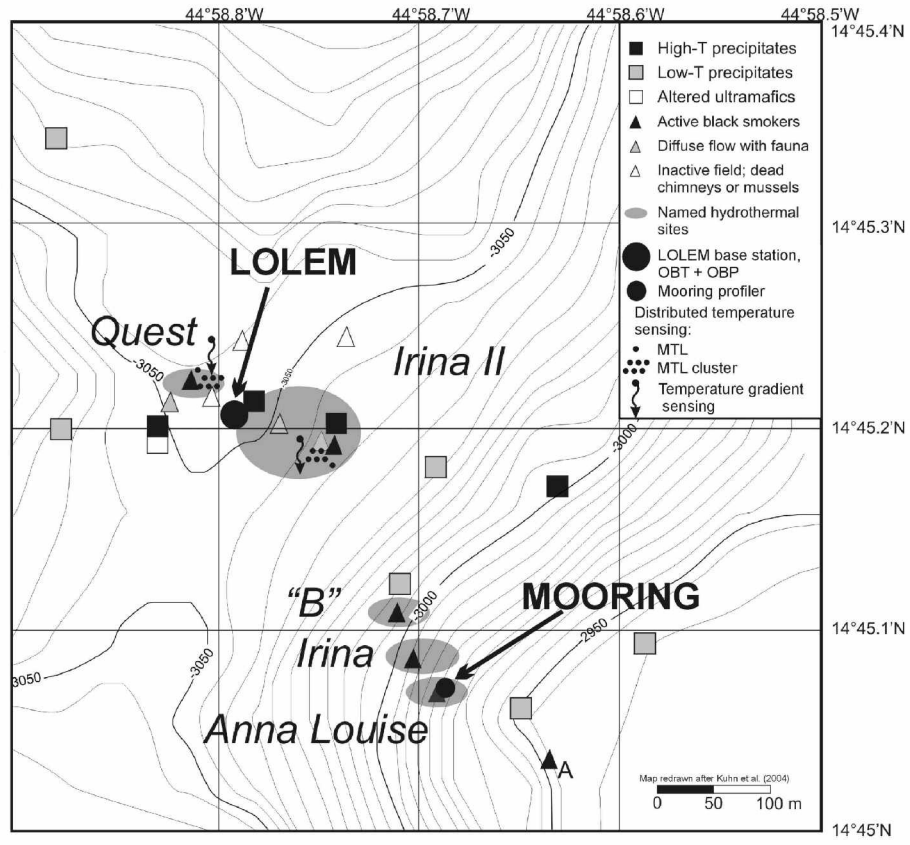


Fig. 2.9: The map shows the location where monitoring systems were installed. QUEST and IRINA II were equipped with temperature loggers, OBT and OBP and MOORING with the bottom water monitoring profiler.

The Ocean Bottom Pressuremeter (OBP), which was deployed close to the OPT (Fig. 2.10), measures changes in the water pressure at the sea floor very precisely to get exact local information about tides and level changes due to subsidence or uplift of the seafloor, indicating tectonic magmatic or hydrothermal activities. The OBP was designed very robust with a strong frame on three short legs and the pressure cases installed with clambs inside. The instrumentation consists of 3 pressure cases with a Brancker XR-420 data logger with built-in temperature sensor, a lithium battery pack (10,5 V, 56 Ah) and a Paroscientific Digiquarz pressure gauge.

This base station was configured to sample pressure and temperature at 2 min intervalls. A 30 s pressure integration time was chosen providing a pressure resolution > 1 mm water column. This base station was brought to the sea floor (19.05.05, station 244ROV dive 52) and repositioned to it's final position (22.05.05, station 263ROV; dive 57). Crucial for the choice of the position was a location where no level changes due to sinking of the instrument into the sediment or due to redeposition of sediments was expected. The final deployment position shows only minor ripples indicating little sediment transport and closeby outcropping solidified material suggests only thin sediment cover.

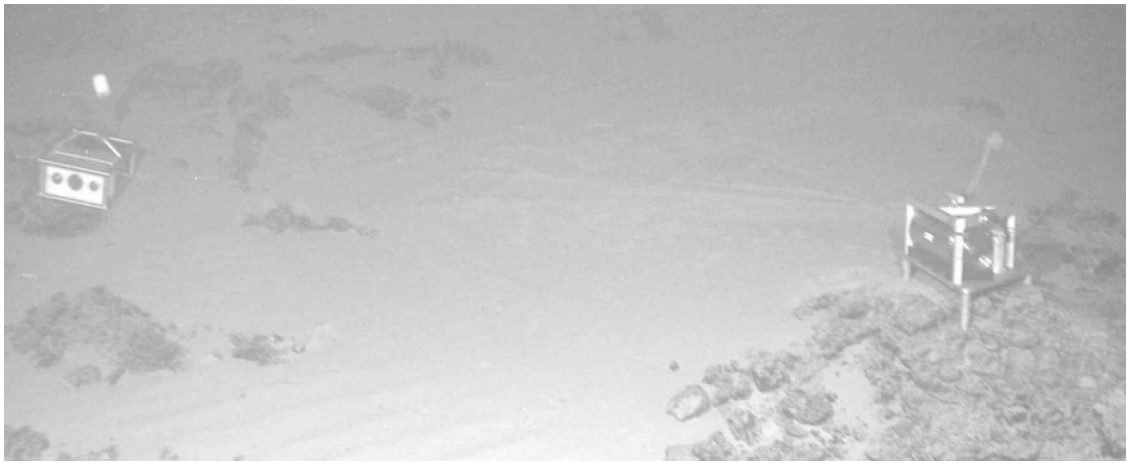


Fig. 2.10: OBP (left) and OBT (right) deployed at their final positions west of IRINA II.

The distributed temperature sensing instrumentation monitors temperature variations in the biological communities as an indicator for changes in their living environment due to variations in hydrothermal activity. So the deployment locations were chosen at spots of focussed biological and fluid sampling investigations.
The set of instruments consists of 20 1-channel temperature loggers (MTL) inserted into 40 cm long T-shaped steel tubes for easy ROV-deployments and four units each of a 8-channel temperature lance connected to a data logger with a 1 m cable. The temperature resolution is < 1 mK at an absolute accuracy < 5 mK. The 1-channel loggers were set up to sample at 6 min intervals, the 8-channel loggers at 2 min intervals.
The first set of instruments consisting of 10 1-channel loggers sequentially numbered from #1854200 to #1854209 was labeled with 10 cm buoyant cylinders #0 to #9. They were deployed (20.05.05, station 257ROV, dive 55) in the IRINA II mussel field (Fig. 2.11) The arrangement was installed in two parallel lines of 5 loggers each perpendicular to the mussel field's length axis until the rim of the mussel covered area. Shimmering water indicates elevated water temperature above the mussel field.

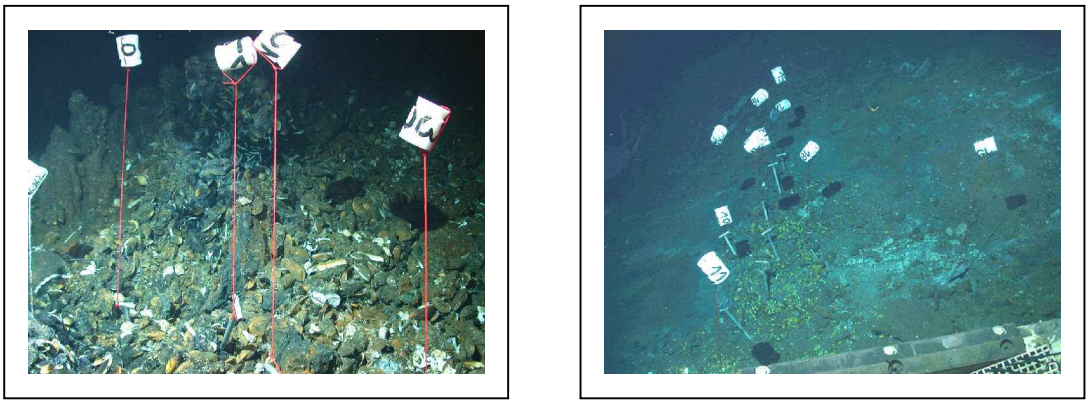


Fig. 2.11: Part of the 1-channel temperature logger array in IRINA II mussel field (left) and QUEST mussel field (right).

The second set of 10 MTLs (#1854210 to #1854219) labelled as #10 to #19 was deployed (30.05.05 station 281ROV, dive 61)) in the QUEST mussel field (Fig. 2.11) which has an extension of about 0.6 x 3 m . The loggers were arranged along the field's length axis spaced < 0.5 m with an additional cross profile and one extra logger 1 m beside in a bacteria mat.
Two 8-channel loggers (#10295, #10298) were placed (31.05.05, station 283, dive 62) horizontally and vertically at the same location where the mussel field shows maximum thickness. An other set of two 8-channel loggers (#10296, #10297) was placed in the same configuration in the IRINA II mussel field, ca. 4 m beside the 1-channel logger array.
Two MTLs deployed during cruise M60/3 were recovered from the IRINA II and QUEST site mussel fields. Data show in a 1 week time series periodic changes in temperature up to 6°C resp. 12°C with a periodicity which seems to be related to the ocean tides or multipliers of it.

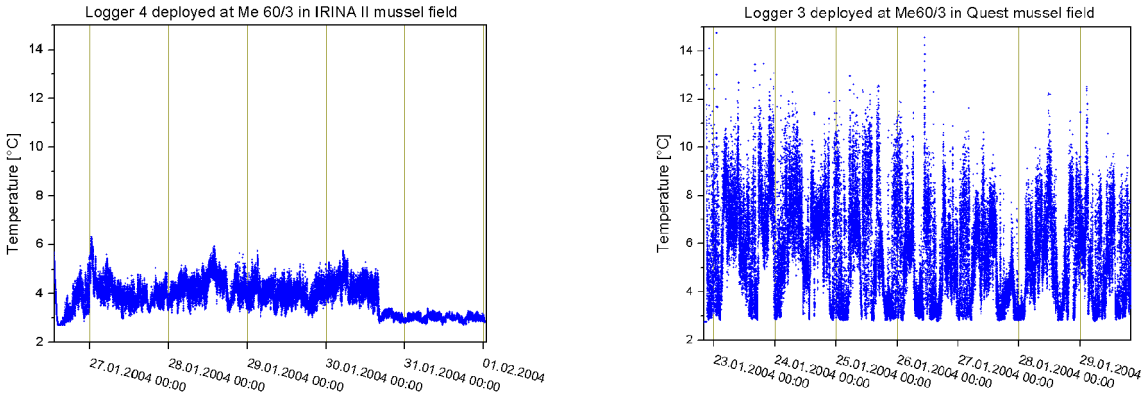


Fig. 2.12: Temperature time series in IRINA II (left) and QUEST (right) mussel field.

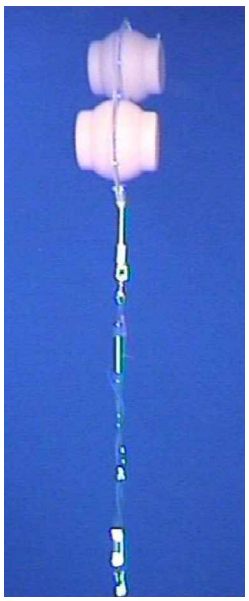


Fig. 2.13: The BWPM

The bottom water profile monitor (BWPM) will register the variation of the bottom water temperature caused by changes in hydrothermal activity and water currents.
The BWPM is constructed as a mooring where two 17' glass balloons with a total buoyancy of 56 kg are connected by a 25 m long rope to a bottom weight of 100 kg (Fig. 2.13). A 25 m long sensor cable with 24 temperature sensors 1 m spaced and a Brancker XR-420-T24 24 channel data logger are attached to it. Acoustic beacon #15 was also attached to the mooring 20 m above the sea floor for easy finding and general navigation purposes in the Logatchev hydrothermal field. The logger is configured to register the temperature in 1 min time intervals at 24 equidistant positions equally spaced by 1 m at a temperature resolution of better than 1 mK and an absolute accuracy of 5 mK.
The BWPM was lowered to the sea floor with the oceanographic wire, an additional weight of 300 kg and an acoustic releaser. The ROV collected the mooring from the sea floor by grabbing into a prepared loop of buoyant rope attached to the bottom weight and transported it to the final position between the black smokers and smoking craters of ANNA LOUISE and IRINA I. While the location is in the vicinity of these highly active areas to get significant signals, the BWPM keeps outside the high temperature vents.

Environmental mapping and online tools

The ROV temperature lance is intended to measure real time temperature at spots of interest as well as the gradient and width of the temperature anomalies. It is designed as a 0.5 m long lance with 8 evenly (4 cm) spaced temperature sensors inside and connected to a 8-channel logger. The logger provides a RS-232 data stream, which is transmitted in real time through the ROV-cable to the ship.
The lance measured temperatures of up to 210 °C in a black smoker at ANNA LOUISE. Additonally mussel fields and bacteria mats were probed. Finally the connector at the lance broke as it was not sufficiently robust for the ROV handling; it will be replaced by a stronger one for the next cruise.

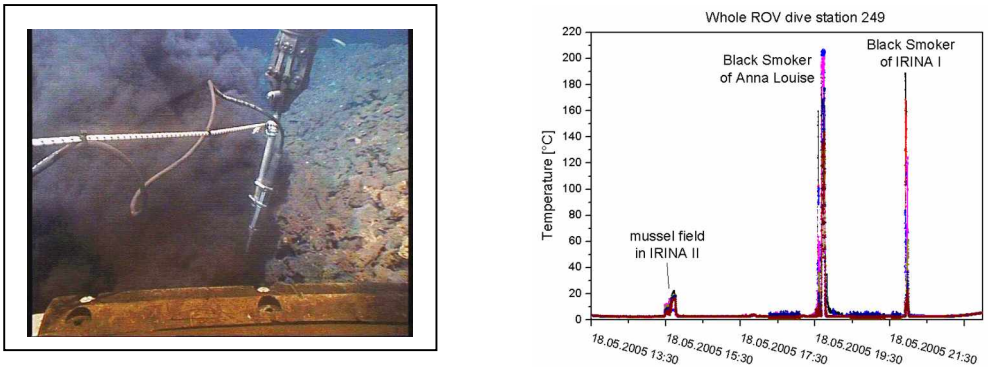


Fig. 2.14: 8-channel ROV-temperature lance placed in the black smoker of ANNA LOUISE (left) and the results (right).

With the plume temperature profiler the water column is scanned for signs of a hydrothermal plume. For this purpose a set of MAPRs and 20 miniature temperature loggers (MTL) were attached to the oceanographic wire and towed through the water column while the ship was steaming slowly at 0.5 knts.
During station 223 a grid of 4 equally spaced parallel profiles covering an area of about 4 km^2 above the Logatchev hydrothermal vent field was surveyed. MAPRs and MTLs were attached over a length of 600 m. The TowYo approached the sea floor to 50-100 m with an amplitude of 200 m. During station 228 the variation of temperature and turbidity were recorded in the center location of station 223.
All surveys revealed that the upper plume between 2700 m and 3000 m is very clearly visible by increased turbidity in MAPR and CTD data. At the same time a sudden decrease in temperature gradient compared to the normal gradient is observed. The signal in the temperature is less obvious than the one in the turbidity.

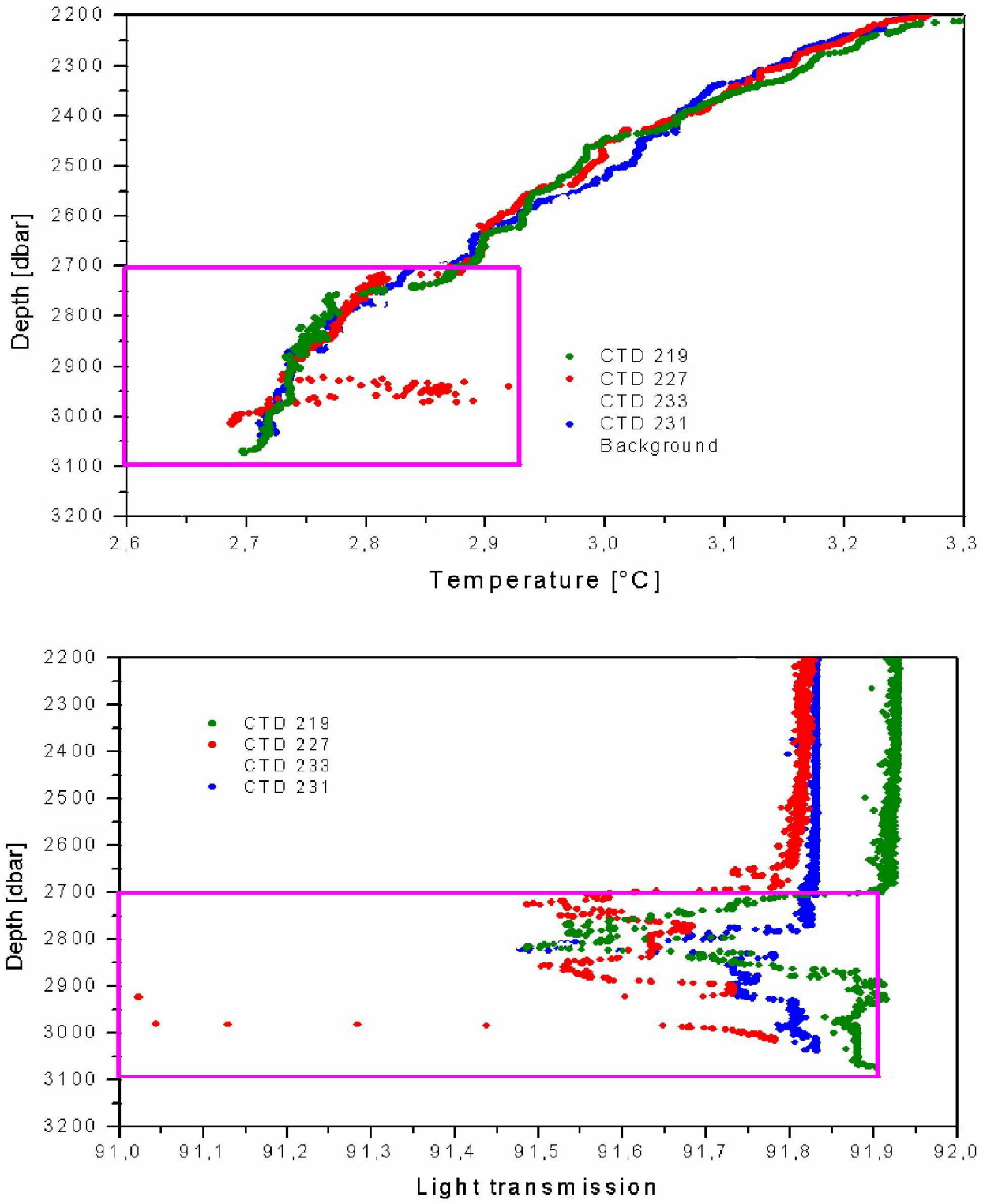


Fig. 2.15: Comparison of temperature and turbidity signal at the same time and position in the upper plume above the Logatchev hydrothermal field in a depth of 2700 to 3000m, indicating it's easier recognition by turbidity measurements.

At station 284 the OFOS was used to follow the sea floor with a constant distance of 2 m, while observing the sea floor for indicators of hydrothermal activity. A set of 20 MTLs and 5 MAPRs were attached to the wire and to the bottom distance control weight below the OFOS. This way the bottom water column of 100 m was surveyed in detail on three parallel tracks evenly spaced by 100 m.

Different from the upper plume, a bottom water plume could be identified in the interval between 2-10 m above the seafloor. This bottom plume is seldom visible by increased turbidity, but can be easily identified by temperature signals of 30 mK to 50 mK. The bottom plume seems to indicate hydrothermal activity from diffuse venting sites, which don't produce big amounts of particles like the black smokers do. Thus future cruise could be guided by observing the temperature anomalies in that depth interval to find diffuse venting sites.

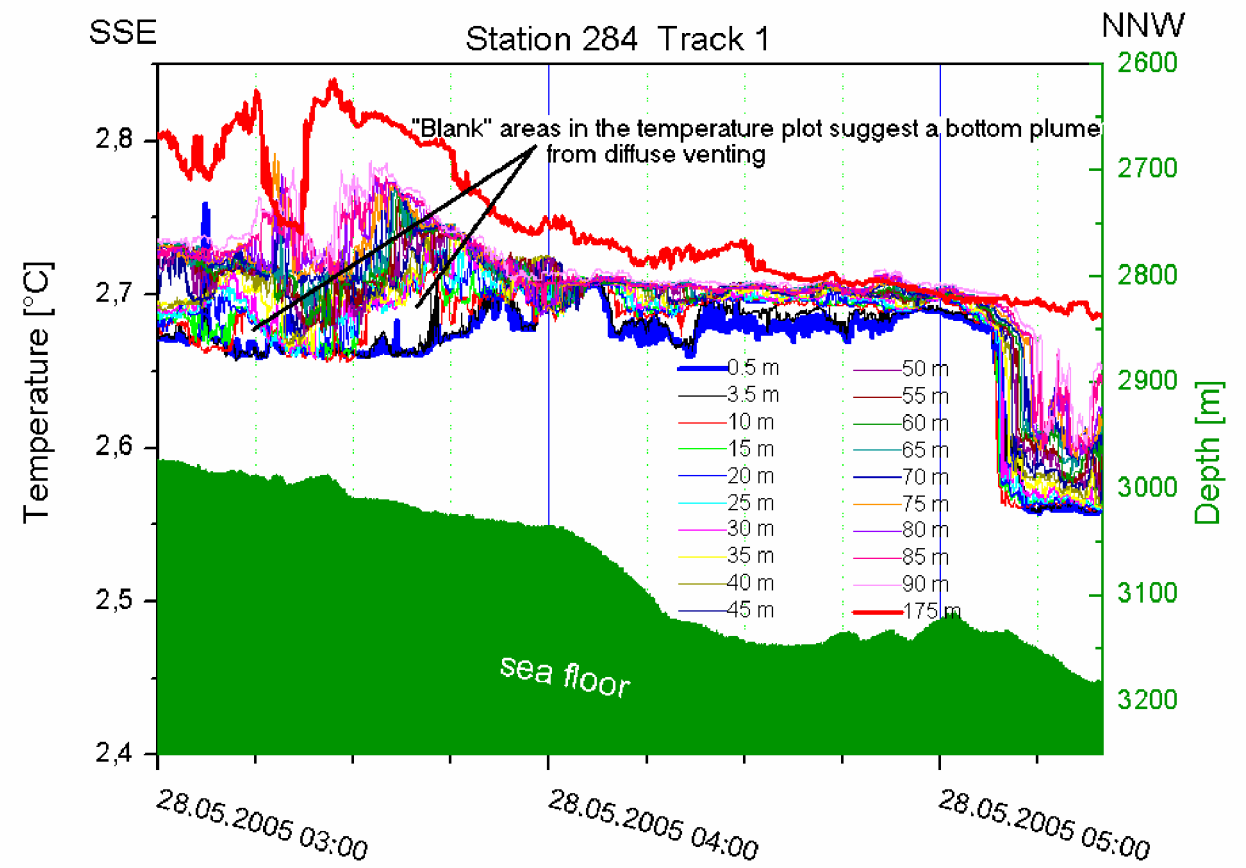


Fig. 2.16: Several "blank" areas in the temperature graph between the bottom sensor and sensors of more than 10 m above the sea floor indicate diffuse venting, as was proved by finding in the vicinity of the marked spots. No turbidity anomaly was found in these cases. Future investigations of the Logatchev hydrothermal field could be guided by this finding.

Results from station 226 suggest to have a closer look to an area 500 - 1000 m to the NW of the Logatchev vent area for diffuse venting sites.

More about the physical observations in the water column can be found in a separate section “plume mapping” in this report, because the operations of CTD and MAPR were conducted in close collaboration with scientists from the gas and fluid chemistry group.

2.4.6 Physico-chemical characterization of the Logatchev hydrothermal field

2.4.6.1 Gas chemistry

(T. Pape, G. Schroll)

During a previous cruise to the Logatchev hydrothermal venting site with R/V METEOR in 2004 (M60/3) comprehensive analysis was performed for the gas chemical characterization of hydrothermal fluids and plumes. This work yielded gas concentrations and stable isotope signatures of CH_4 and H_2 of numerous fluids sampled at distinct emanation points. Considerable differences in absolute and relative gas concentrations, and fluid temperatures (calculated from stable isotope composition of H_2) between the distinct fluids could be shown (Kuhn et al., 2004). Water column investigations revealed a distribution of hydrothermal signatures covering the water depth range from 2.500 to 3.000 m. However, due to a limited number of hydrocasts these data did not allow for a detailed characterization of the horizontal distribution of the entire hydrothermal plume.

Main objectives of the gas chemistry analysis performed during M64/2 were to determine the composition of distinct fluids and the vertical and horizontal extension of the gas plume in the water column above the Logatchev field, both with emphasis on variations compared to the earlier investigation. For this purpose, samples of hydrothermal fluids and plumes were recovered during several ROV dives and CTD stations and analysed for the concentrations of the main reactive gases hydrogen and methane. These investigations aimed to detect the gas chemical cyclicity of the Logatchev hydrothermal vent system. Reported here are preliminary results of CTD-profiling and gas analysis.

Samples and methods

During M64/2 34 CTD stations were conducted for measurements of conductivity, temperature, salinity, and light transmission of the water column. A map illustrating the positions of the stations is given in chapter 2.4.6.1. CTD data were recorded for the entire water column using a SEABIRD CTD Type 911 equipped with a light transmission sensor. At 19 stations water samples were taken with a rosette of 23 10 L Niskin bottles for on board analysis of concentrations of H_2 and CH_4. Fluid and near-bottom water samples were obtained by a fluid sampling system or Niskin bottles during 12 ROV dives. Subsamples were stored for onshore measurements of stable carbon isotopic compositions of CH_4 and H_2. In total, 146 samples from the water column and 35 vent associated water and fluid samples were recovered for analyses of dissolved gases (Table 2.1).

Table 2.1 Water sample list for CTD- and ROV-stations

Station	Long. N	Lat. W	No. of samples	HC	H_2	$\delta^{13}CH_4$	δ^2H_2
CTD							
217	13°30,0´	45°00,0´	12	12	11		
219	14°45,2´	44°58,8´	12	12	11		
221	14°45,1´	44°58,9´	12	12	12		
227	14°45,1´	44°58,7´	10	9	8		
231	14°45,3´	44°58,9´	11	11	11	10	
242	14°46,0´	44°58,8´	5	5	3	3	
248	14°46,0´	44°59,0´	11	11	9	10	
253	14°46,1´	44°59,2´	10	10	8	8	
260	14°46,0´	44°59,1´	11	11	9	10	
264	14°45,2´	45°01,0´	6	6	6	5	
267	14°44,0´	44°59,0´	4	4	2	4	
268	14°44,0´	44°58,0´	4	4	4	4	
269	14°44,4´	44°57,0´	3	4	1	2	
270	14°44,5´	44°57,5´	4	4	3	4	
273	14°46,0´	44°59,2´	10	10	10	10	
274	14°45,1´	44°58,1´	4	3	3	3	
275	14°44,4´	44°57,2´	3	3	2	1	
276	14°45,7´	44°57,5´	4	3	3	3	
279	14°45,4´	44°58,9´	10	10	10	10	
total: 19			**146**	**144**	**126**	**87**	
ROV							
224			2	1	2	2	
232			4	2	4	2	
249			4	2	4	4	2
257			2	1	2	2	
261			7	5	7	4	
263			1	1	1	1	
266			4	2	4	4	
272			1	1	1		
277			2	1	2	2	
281			4	2	4	3	
283			2	2	2	2	
285			2	2	2	2	
total: 12			**35**	**22**	**35**	**28**	**2**

HC = CH_4 and C_2- to C_4-hydrocarbons

The methods used for preparation and on board analysis of dissolved gases and storage of gas and water samples are described in the cruise report of M64/1 in detail. Briefly, volatile dissolved hydrocarbons (C_1 to C_4) were extracted and concentrated deploying a purge and

trap technique (Seifert et al., 1999). The trapped gases are released to a gas chromatograph (CARLO ERBA GC 6000) equipped with a packed stainless steel column and a flame ionisation detector (FID) and connected to a PC based data handling software to separate, detect and quantify individual compounds.

Dissolved hydrogen was extracted by applying a high grade vacuum in an ultrasonic bath and heating until boiling. Subsamples of the released gas were transferred from the degassing unit into the analytical system using a gas tight syringe. The analytical procedure was performed using a gas chromatograph (THERMO TRACE GC ultra) equipped with a packed stainless steel column and a pulse discharge detector (PDD). All analytical procedures were calibrated daily with commercial gas standards (LINDE).

For onshore analysis of stable carbon isotopes (^{13}C) of dissolved light hydrocarbons aliquots of gas samples obtained by the vacuum-ultrasonic technique were transferred through a septum into gastight glass ampoules filled with NaCl-saturated water. For selected water samples aliquots of the vacuum-extracted gas were frozen on molecular sieve 4Å under liquid nitrogen in a pre-vacuated glass vial for onshore measurements of stable hydrogen isotopes.

Preliminary results

Based on results obtained during previous water column investigations at the Logatchev hydrothermal field (LHF) CTD surveys were deployed above vent sites and at adjacent (max. about 3 nm) non-vent areas. Signatures of hydrothermal activity within the water column were monitored by anomalies in the transmission profiles and S/T diagrams (salinity vs. potential temperature). Generally, the hydrothermal anomalies in the working area are located at a water depth range between 2.700 and 2.900 m (Fig. 2.17).

The S/T diagrams indicate that the intrusions are derived from fluids depleted in salinity compared to sea water generating distinct water bodies of elevated temperatures (Fig. 2.18). At station CTD231, which was performed about 0.15 nm NW of the Black Smoker 'Quest', the hydrothermal plume peaked at 2.787 m depth.

Furthermore, a good correlation between transmission anomalies and the concentration

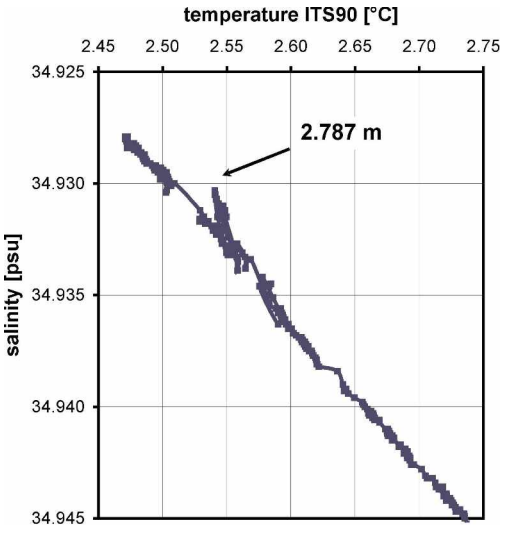


Fig. 2.17: Concentrations of H_2 and CH_4 in water samples of all CTD stations.

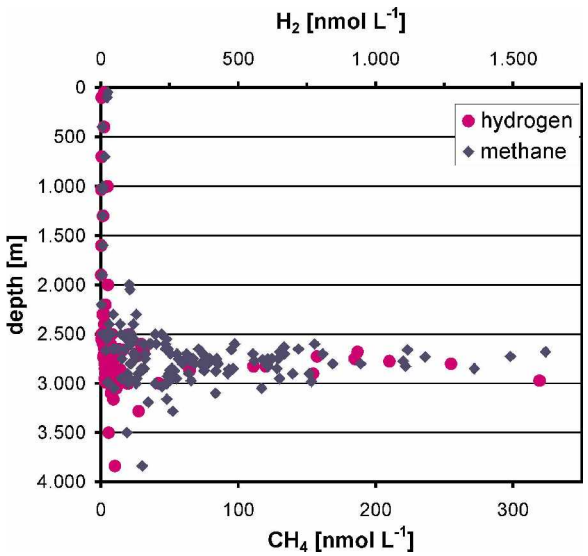


Fig. 2.18: S/T diagram of deep waters at station CTD 231, 2.550 to 2.960 m.

profiles of hydrogen and methane was found at this station (CTD231; Fig. 2.19). However, at some other CTD stations we found minor similarities between profiles of these physico-chemical parameters.

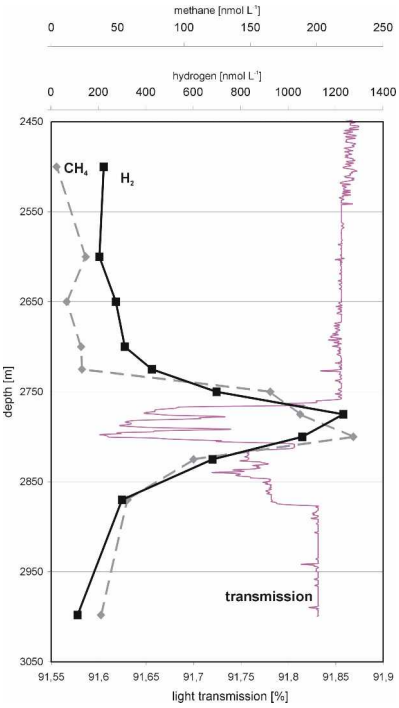


Fig. 2.19: Concentrations of H_2 and CH_4 and light transmission anomaly at station CTD231.

During M64/2 concentrations of dissolved gases obtained from CTD/rosette water samples revealed a considerable hydrothermal signature over a wide distribution area. A map illustrating the area where distinct anomalies in the turbidity profiles were observed is given in chapter 2.4.6.2, Fig.2.20. Highest concentrations of dissolved hydrogen and dissolved methane were observed for station CTD227 showing about 1.6 µmol L^{-1} H_2 (2.972 m depth) and about 0.3 µmol L^{-1} CH_4 (2.680 m), respectively. This station was positioned equidistant to the hot fluid emanation sites 'Irina' and 'Site A' and, as far as we know, these are the highest H_2 concentrations measured in the water column above the LHF.

Moreover, at station 238, where no water samples were taken, a slight transmission anomaly at 3.030 to 3.080 m accompanied by elevated concentrations of hydrogen in near bottom waters at the nearby station CTD273 was observed. Since both stations were located more than 2 nm NW off the LHF, these observations might be related to fluid emanation sites in the NW edge of the working area undiscovered so far. However, during ocean bottom observation tracks conducted with an OFOS system no hints for effusive or even diffusive vents were recognized (see chapter 2.4.3).

Water and fluid samples taken with 5 L Niskin bottles or a fluid sampling device (KIPS) directly at fluid emanation sites during ROV dives commonly showed very high concentrations of dissolved gases. In fluids obtained by putting the tip of the fluid sampling system directly into the outlet of black smokers, maximum concentrations of methane were 397.8 µmol L^{-1} (at Irina I, ROV249). Highest concentrations of dissolved methane in water samples taken with the ROV-based Niskins were found at the same site and accounted for 67.5 µmol L^{-1} (ROV261). Further insights into the variability in the gas chemistry of fluids at the LHF will be obtained after reevaluation of on board data and by stable isotopes analysis of the comprehensive sample set in the home lab.

2.4.6.2 Spatial distribution of the hydrothermal signature in the water column

(H. Marbler, T. Pape, H.-H. Gennerich, G. Schroll, S. Weber)

In order to determine the horizontal expansion and vertical structure of the hydrothermal plume at the Logatchev hydrothermal field (LHF) a plume-mapping was carried out.
During selected hydrocasts with CTD/rosette water sampler 25 measurements of the water column were conducted as one-point on-line measurements with CTD combined with light transmissiometer, associated MAPR (Miniature Autonomous Plume Recorder with turbidity, density and temperature sensors) and MTL (Miniature Temperature Logger). Time series measurements were also carried out with five MAPR and 20 MTL in different depths. A so-called “towyo-mapping” with MAPR and MTL was performed in four parallel S-N profiles over the vent field.
For seafloor observations combined with the determination of geophysical parameters of the near bottom plume an OFOS (Ocean Floor Observation System) combined with MAPR and temperature logger in defined levels were used (see Chapter 2.4.3).

Table 2.3: Station numbers with coordinates and the number of CTDs, MAPRs and temperature loggers

Station No.	Long. N	Lat. W	CTD	MAPR	Temperatur e-Logger
217 CTD	13°30,0´	45°0,0´	1	1	1
219 CTD	14°45,2´	44°58,8´	1	1	1
221 CTD	14°45,1´	44°58,9´	1	1	1
223 Logger	Track			5	20
226 OFOS			1		
227 CTD	14°45,1´	44°58,7´	1	1	1
228 Logger	14°45,1´	44°58,7´		5	20
233 CTD	14°45,3´	44°58,8´	1	1	1
242 CTD	14°46,0´	44°58,8´	1	1	1
245 CTD	14°45,9´	44°59,3´	1	1	1
246 CTD	14°46,4´	44°59,5´	1	1	1
253 CTD	14°46,1´	44°59,2´	1	1	1
254 CTD	14°45,9´	44°59,2´	1	1	1
255 CTD	14°45,7´	44°59,3´	1	1	1
256 CTD	14°45,4´	44°59,5´	1	1	1
260 CTD	14°46,0´	44°59,1´	1	1	1
264 CTD	14°45,2´	45°01,0´	1	1	1
265 CTD	14°44,0´	45°00,0´	1	1	1
267 CTD	14°44,0´	44°59,0´	1	1	1
268 CTD	14°44,0´	44°58,0´	1	1	1
269 CTD	14°44,4´	44°57,0´	1	1	1
270 CTD	14°44,5´	44°57,5´	1	1	1

Station No.	Long. N	Lat. W	CTD	MAPR	Temperatur e-Logger
273 CTD	14°46,0´	44°59,2´	1	1	1
274 CTD	14°45,1´	44°58,1´	1	1	1
275 CTD	14°44,4´	44°57,2´	1	1	1
276 CTD	14°45,7´	44°57,5´	1	1	1
278 OFOS			1		
279 CTD	14°45,4´	44°58,9´	1	1	1
280 CTD	14°47,0´	45°00,0´	1	1	1
284 OFOS	Track		1	5	20

Preliminary Results

During 25 CTD Stations (Tab. 2.3; Fig. 2.20) with associated MAPR (10 meters above the CTD) several turbidity anomalies were detected. Above LHF we observed turbidity plumes in two depths. One plume intrudes the water column between 2.620m to 2.800 m water depth and a second one was found between 2.920 m and 2.980 m (for example CTD219; Fig: 2.21). The latter is only observed in the close vicinity of LHF.

2 km northwest of LHF a continuation of the upper plume can be stated, while in the lower lewel a new strong turbidity plume was located between 2.750 m and 3.000 m (CTD 260; Fig. 2.21). This anomaly was observed in three CTD and MAPR stations. Between this northern anomalous zone (NAZ) and LHF the lower plume could not be detected, indicating that a different, while still unknown vent site as source exists. The near bottom plumes at NAZ and LHF consist of turbidity anomalies and very high CH_4 and H_2 values indicating individual hydrothermal sources at both locations.

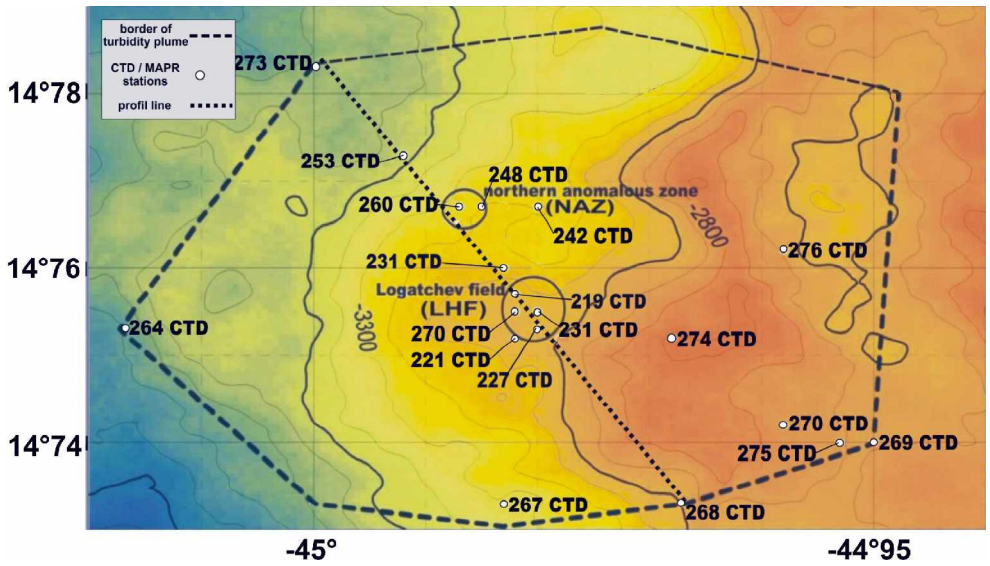


Fig. 2.20: Map of the CTD and MAPR stations (white dots) in the area of the Logatchev vent field and the northern anomalous zone. The dashed line around the area marks the zone of sites where a turbidity anomaly could be recognized. It links CTD stations with strongly reduced turbidity anomalies. The circles show zones, where near bottom turbidity was

observed. The dotted line through these zones marks the profile of the 2D- plume representation (figure 2.22).

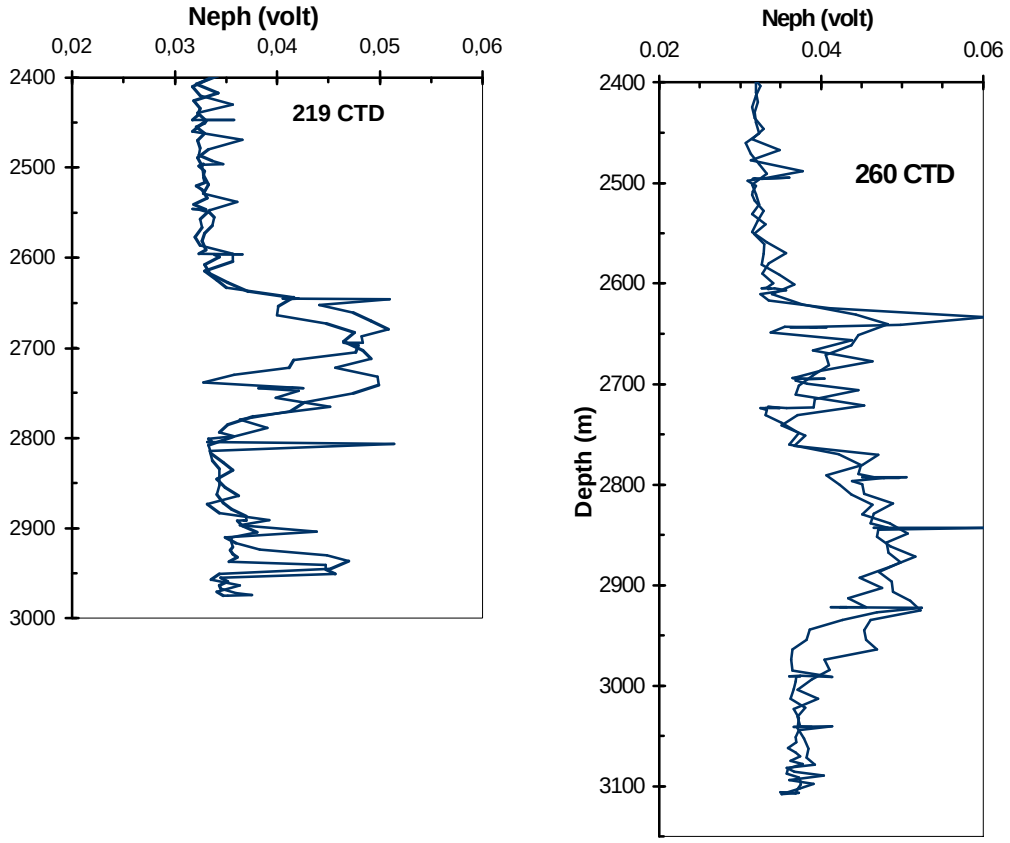


Fig. 2.21 : Turbidity (Nephelometer volts) vs. water depth from MAPR-data at CTD stations above the Logatchev vent field (219CTD) and at the northern anomalous zone (260CTD).

With an array of CTD stations and associated MAPR the extension of the turbidity plumes was mapped. A CTD reference station was conducted some km west of the studying area. In the map (Fig. 2.20) the lateral extent of the upper plume is illustrated by a strong dashed line. Close to the individual fields (LHF and NAZ) the extension of the local lower plume is added by a circle.

The strongest turbidity signal is generally observed in the upper plume at 2700 m to 2900 m depth. The disappearance of the turbidity plume in a distance of some km from the vent is explained by the sinking of Fe-oxides, Fe-oxihydroxides and Mn-oxides not too far from their origin.

The SSE-NNW profile (see map fig. 2.20) of the hydrothermal plume through the Logatchev field and the northern zone shown in Fig. 2.22 is based on the interpretation of 11 CTD-MAPR stations. The cross-section shows a stratification of the turbidity plume especially above the Logatchev field with an extra turbidity plume closer to the seafloor.

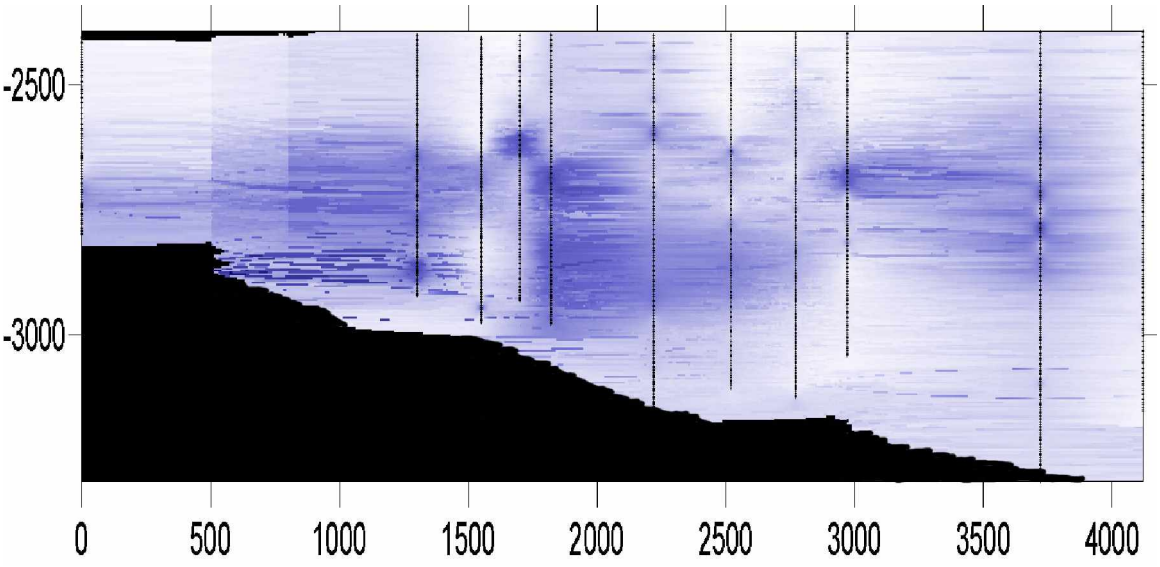


Fig. 2.22: SSE-NNW profile of the hydrothermal plume covering the LHF and the northern zone. The shading indicates the intensity of the turbidity, the y-axis shows the water depth (m) and the x-axis the distance (m) from the first CTD-MAPR station of this profile in the SSE. The Logatchev vent field is situated at about 1300 m distance and the northern zone at 2300 m in the profile.Vertical black lines indicate the location of the CTD and MAPR station, on which this visualization is based.

To record the time variations within different plume levels in the water column a station with five MAPR and 20 MTL was carried out above the LHF during an eight hour station. Large time variations were observed especially in the lower part of the plume, like 75 and 175 m above the seafloor. Within the water depth between 2.700 m to 2.625 m (250 and 325 m above the seafloor) the turbidity level is less variable, which indicates a homogenous distribution of hydrothermal fluid in this level of the water column. In this buoyant plume the turbidity spreads within a distinct depths range.

2.4.7 Fluid chemistry

(M. Amini, D. Garbe-Schönberg, H. Marbler, K. Schmidt, H. Strauss)

One of the major objectives for cruise M64/2 was the detailed investigation of spatial and temporal variations in fluid composition within the Logatchev hydrothermal field. Re-sampling of all sites visited during M60/3 in 2004 and complete coverage of all known Logatchev vent sites could be accomplished during this leg.
Three different types of samples were collected for chemical and isotopic analyses: (1) water column samples from the CTD/Rosette, equipped with 24 Niskin flasks à 10 l volume; (2) samples from discharging vent sites collected with three Niskin flasks (5 l volume), mounted at the front of the MARUM ROV QUEST; (3) in situ-vent fluid samples collected with the new Kiel Pumping System (KIPS: 15 bottles à 675 ml).

Fluid Sampling System (KIPS)

For in situ-sampling of hydrothermal fluids directly from inside the vent orifices a pumped flow-through system (Kiel Pumping System, KIPS) mounted on the ROV's starboard back side was used.

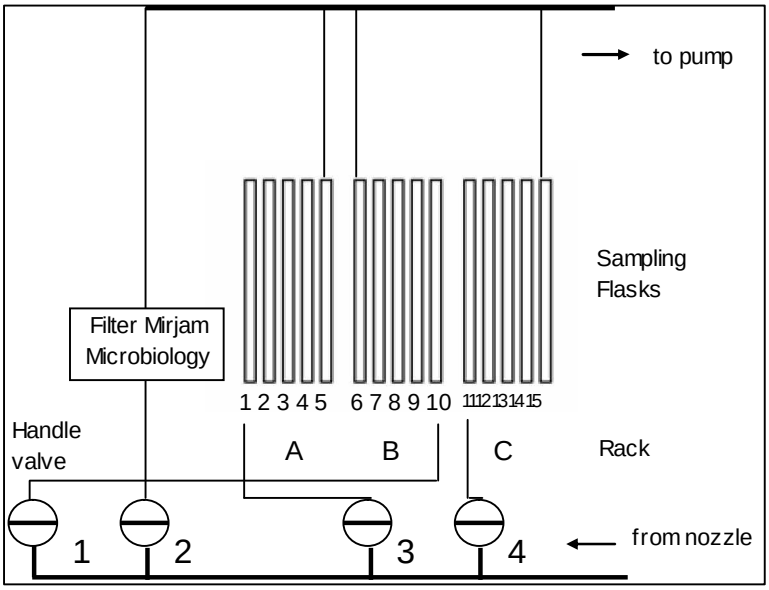


Figure 2.24: Schematic configuration of the KIPS fluid sampling system for e.g., Station 249ROV.

The system is newly constructed and entirely made of inert materials (Teflon, titanium). Samples are collected via bent titanium nozzle of 50 cm length which can be directly inserted into the vent orifice by the ROV`s manipulator arm (Fig. 2.25). Parallel to the nozzle is an on-line temperature probe monitoring the *in situ*-temperature at the point of sampling. Coiled PFA tubing connects the nozzle to 4 handle-operated open-close valves (Fig. 2.24) allowing the distribution of the vent fluids directly to either a series of PFA sampling flasks or an in-line filter holder for microbiological studies or a remotely controlled multiport valve (PETP/ PTFE) driven by a ROV actuator (Schilling, U.S.A). The valve control software is fully integrated in the ROV control system (MARUM, Bremen). The multiport valve in its current design has 18 ports which can be connected to 15 single PFA Teflon flasks (675 ml volume each, Nalgene, USA). A deep sea pump with nominal 3 l/min is mounted downstream to the sampling flasks with the outlet tube ending on the porch at the front-size of the ROV so that outflowing shimmering water could be observed during pumping. The flasks are mounted in three racks A-C, with every rack containing five horizontally positioned bottles, allowing an easy transfer of the racks to the laboratory where sub-sampling was done. Each bottle can be equipped with check valves at the inlet and outlet. An additional multiport valve for a series of microbiology filter units can be connected as a slave valve to one of the free positions (#16-18) of the first multiport valve.

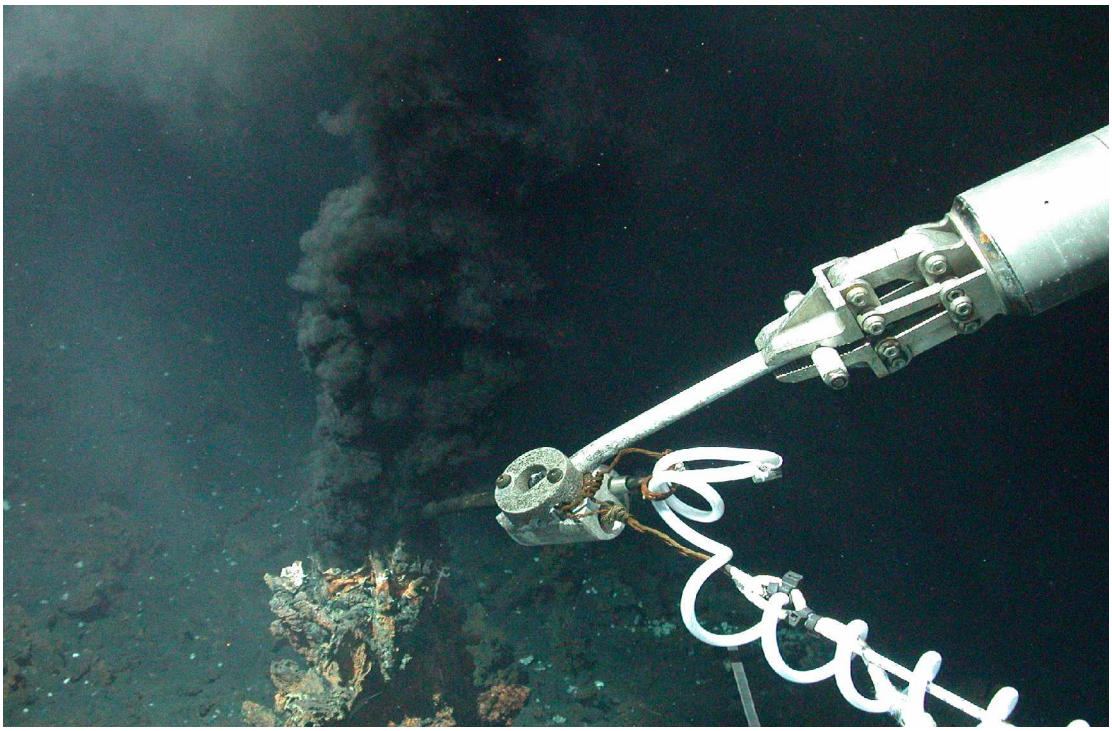


Figure 2.25: Fluid sampling at Site “B” (257ROV-7) with KIPS.

A pre-cruise inquiry on sample volumes needed for their investigations was made in cooperation with the participating groups and resulted in a total of 625 ml sample volume per location. On basis of this information, the pumping system was originally designed for filling 1-2 bottles (0.7-1.5 litres) at one sampling location. However, it turned out during this cruise that it was necessary to fill 5 bottles (3.5 litres) at every site in order to fullfill the many fluid sample reQUESTs. As a consequence, total pumping time increased to 1 hour per site for a full exchange of pre-filled bottom seawater in the 5 flasks. Another consequence was that 5 flasks could not be homogenized prior to sub-sampling. The final KIPS configuration during M64/2 was: Handle valve #1 connected to either Rack A (5 bottles in series) or to the multiport valve; handle #2 connected to the microbiology filter unit; handle #3 connected to Rack B (3 or 5 bottles); handle #4 connected to Rack C (3 or 5 bottles).

Fluid Sampling and Sample Preparation

A total of 90 water column samples, 15 fluid samples obtained with the ROV fluid sampling system, and 5 ROV Niskin samples were collected (see Appendix 6).

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 active vents, samples 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.

Aliquots were sub-sampled for the following chemical and isotopic analyses: free gas and dissolved gases (CH_4, H_2, abundance and isotopic composition, approx. 1000 ml), total dissolved and particulate major and trace elements (2x 50ml), isotopic composition of Ca (25 ml), high precision alkalinity (250 ml), selected anions (50 ml), sulphate (1 ml) and sulphide (abundance and isotope geochemistry, 400 ml), dissolved inorganic carbon (abundance and isotopic composition, 30 ml), amino acids (2x 75 ml), ammonium (abundance and nitrogen isotopes, 60 ml), and aliquots for subsequent filtration (500-1000ml) and microbiological cultivation work.

On small unfiltered aliquots (30 ml), ph, Eh, total Fe and Fe-II, S^{2-}, and dissolved silica were measured directly after sampling for all samples.

For all other chemical analyses, fluid samples were pressure-filtrated with Nitrogen (99.999%) at 1 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. 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, PFA Teflon). Rinse water was ultrapure (>18.2 Mohm), dispensed from a Millipore Milli-Q system.

For selected samples, about 200 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 $HgCl_2$, respectively, as conservation for organic analyses in the home laboratory.

After return to the home laboratories at University of 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.

At IFM-Geomar in Kiel the isotopic composition of Ca and Sr as well as U for selected samples will be determined by TIMS and MC-ICPMS. Alkalinity will be determined to high precision.

On-board analyses

pH and Eh Measurements

For all samples collected with either the CTD/Rosette, the Niskin flasks or the Kiel Fluid Pumping System (KIPS), 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, fluid samples from hot vents 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 $AgNO_3$-solution, using fluorescene-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 CDT/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 α-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 ferroin 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_{tot} fraction in the sample by reducing all Fe with ascorbic acid. Fe(III) is determined as difference between Fe_{tot} 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 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 Mn, Zn, Cu, Cd, and Pb in all fluid samples and Fe in selected water column 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-dihydroxinaphthalene as complexing agent was applied in samples with low Fe concentrations, while photometry was used for samples with

high Fe concentrations (>0.1 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).

Titration of Alkalinity

Alkalinity was determined onboard for samples of very less amounts and for a cross check with later analyses due to potential modifications by H2S oxidation and/or CaCO3 precipitation.
The measurements are carried out by a titration device after Galina Pavlova. 1 ml of sample was added to 4 ml of Millipore water and 0.02 ml of the indicator (mixture of methylorange and methylenblue). The mixture was titrated by 0.01M HCl until a stable redish colour appears. The released CO2 and H2S respectively was outgassed/displaced by N2. The results are averages of at least three replicated measurements. Analytical uncertainties are in the range of less than 0.7 %.

Results from On-Board Analyses

Vent Fluids

The chemical and isotopic characterization of hydrothermal vent fluids is strongly dependent upon the sampling procedure and the sampling location inside the orifice. Dilution of the emanating hydrothermal fluid by turbulent mixing with ambient seawater within the vent orifice is always likely. In order to qualitatively assess the contribution from seawater, a number of analytical parameters, such as Eh, pH and 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). Mg will be measured in the home laboratories.

The sampled vent fluids are highly reducing and acidic (Fig. 2.26), indicating a low proportion of intermixed oxic seawater. Lowest values obtained for fluid samples were 3.89 for pH and –370 mV for Eh. The highest in-situ temperature measured during this cruise was 350°C (Site “B”), which is nearly identical to the published value from Douville et al. (2002).

Sulfide. The measured dissolved sulfide concentration ranges between 0,5 mM and 2,5 mM for samples directly collected at the vent sites. The published values for ultramafic-hosted hydrothermal fields range between 0,8 mM and 1 mM for the Logatchev Field and Rainbow, respectively (Douville et al., 2002).

Chlorinity. Measured chloride concentrations are slightly lowered compared to seawater (max. 10%). This may indicate phase separation, which must happen in the supercritical region (water depth >3000 m, critical point: 405°C/300bar).

Silica. The silica concentrations range between 0,8 mM und 4 mM and show significant differences between individual sites (Fig. 2.27). Higher concentrations seem to be reflected in more complex vent architectures (IRINA II and possibly Site “A”). The variations between individual sites confirm the trend observed for the samples collected during the M60/3 cruise.

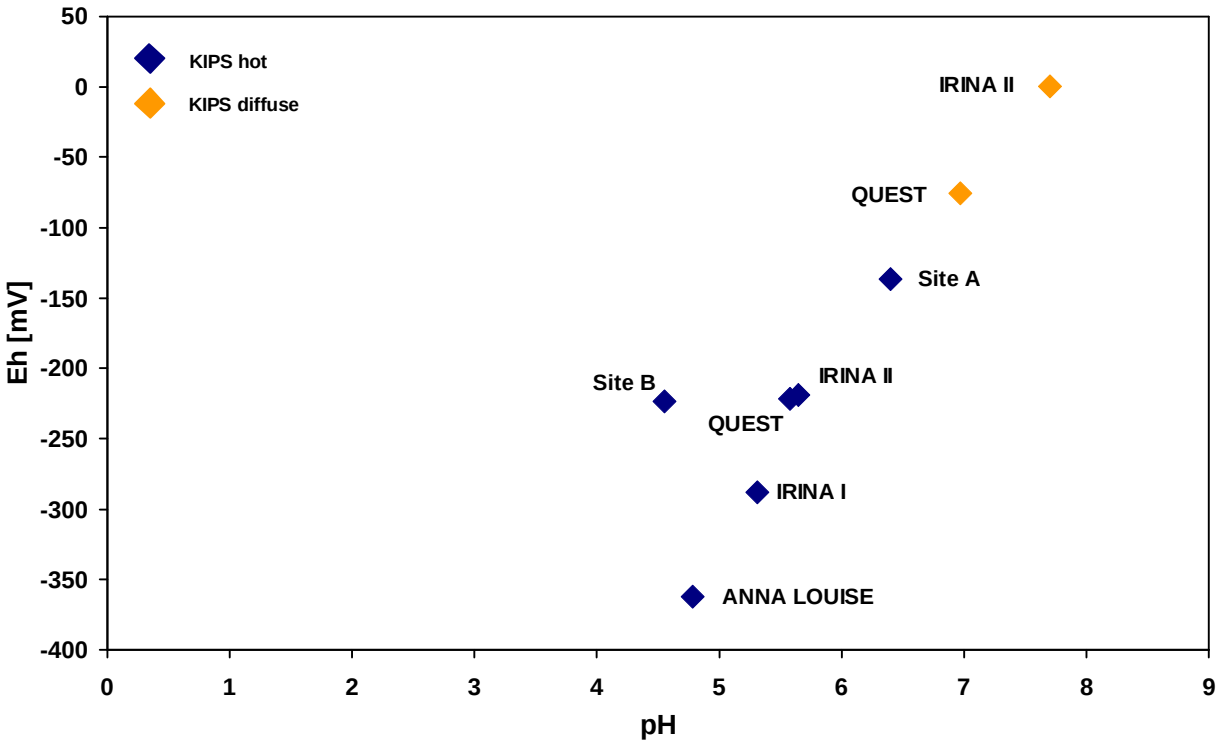


Fig. 2.26: Plot of pH and Eh for fluid samples obtained with the fluid sampling system (KIPS).

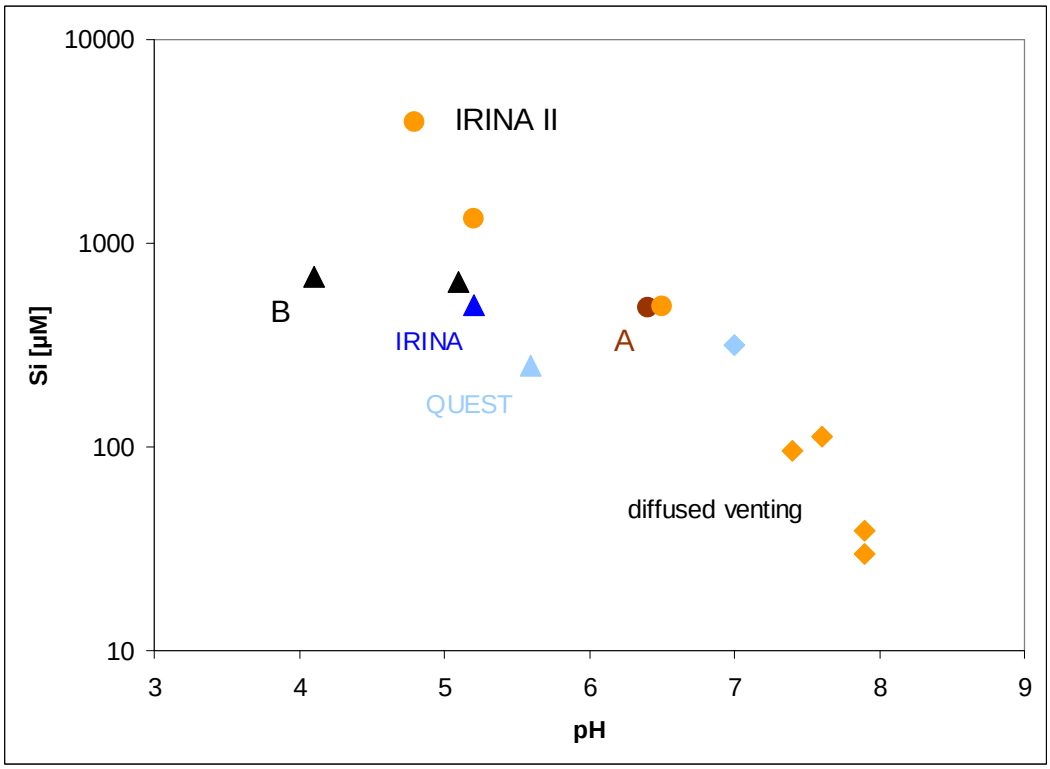


Fig. 2.27: Plot of Si vs pH for KIPS fluid samples. Fluid samples from IRINA II and Site A are characterized by elevated Si concentrations.

Trace metals. Spatial variations can also be seen in the concentrations of Zn and Cu. The highest concentrations were measured at IRINA II (Zn: 4 µM; Cu: 5,1 µM), the lowest at IRINA I and QUEST (less than 1 µM). The low concentrations compared to published data are probably caused by the strong bounding of these chalcophile elements in the precipitating sulfide particles before and during the sampling.

Fe/Mn ratios differ also between the individual sites. For Site "B" and QUEST the highest ever reported values for MAR were found (Fe/Mn=18, Fig. 2.28), resulting from very high total dissolved Fe concentrations up to 2,5 mM (more than 90% as reduced Fe^{2+}). These not yet endmember-corrected Fe data are in the same range as the calculated endmember concentration for the M60/3 fluids.

Diffuse vent fluids sampled at IRINA II and QUEST show intermediate compositions between hot fluids and seawater. They were partly significantly reducing (Eh of –200 mV) and slightly acidic (pH of 6.5). The silica enrichment at IRINA II (see above) can also be seen in the diffuse fluids. Measured sulfide concentrations range between 0,5 µM and 6 µM.

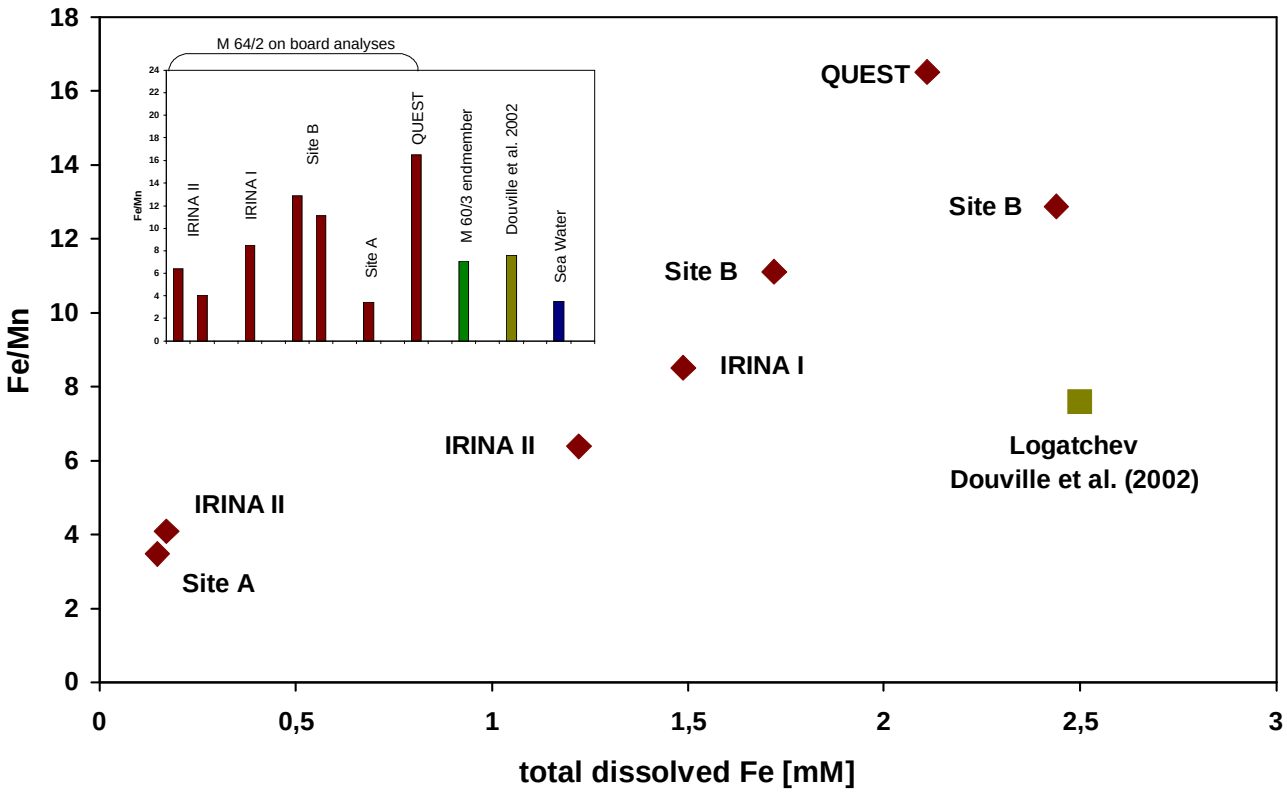


Fig. 2.28: Plot of Fe/Mn vs total dissolved Fe. Insert shows Fe/Mn ratios in comparison to data from M60/3 and Douville et al. (2002).

Alkalinity: The results are listed in table. …As expected the alkalinity of the CTD samples as well as of the diffuse vent samples range between 2.0 and 2.3, which is in accordance with the value of 2.33 yielded for IAPSO and the averaged CTD samples.

Samples taken from smoking vent sites are decreased to more than a quarter of the reference value varying from 0.5 to 1 mM. These values have to be checked and elaborated by potentiometric titration afterwards. Furthermore contributions of carbonate and borate/silicate have to be identified.

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, and hydrogen. Mn and Fe will be analysed in the on-shore labs for a further characterization of the chemical signature of the plume .

2.4.8 Marine microbiology

(A. Gärtner, M. Perner)

The aim of the cruise was the collection of microbial communities from the Logatchev I hydrothermal vent field (LHF I) at 14°45 N in order to perform:

a) Molecular analyses of the microbial community structure (in the home lab)
   - Construction of clone libraries using the 16S rDNA gene (Archaea and Bacteria);
   - 16S rDNA gene targeted DGGE (Archaea and Bacteria).
   - FISH (Fluorescence in situ Hybridization)
   - Functional gene analyses based on key enzymes of CO_2-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_2, H_2S, S°, S_2O_3, Fe^{2+}, CH_4) as well as suitable electron acceptors (O_2, NO_3, Fe^{3+}, Mn^{4+}, S°, S_2O_3) in the presence of CO_2.
   - Selective media for aerobic and anaerobic heterotrophic microorganisms.
   - Incubations along a temperature gradient (20-80°C)
c) On board microscopic observations of microorganisms inhabiting freshly taken samples.
d) In situ cultivation – Nets of porous material were deployed for settlement of local microorganisms:
   - Two nets of porous substrate were positioned above a mussel field with shimmering water at IRINA II and collected after 48 hours. One net was positioned directly above a site of diffusive fluid emanations of the mussel field. The other served as a reference and was placed over a part that had been cleared of mussels within the vicinity of shimmering water. Cultivation experiments using this porous material have begun on board (see b). Molecular analyses of the microbial community that was absorbed by the porous material will be conducted in the home lab.
   - Five substrate nets were placed along the temperature sensor mooring positioned between IRINA I and ANNA LOUISE. The nets are located at a height of 2.5m, 5m,

7.5m, 10m and 20m depth above the seafloor. They will be collected in 6 months time and treated as the 2 day deployments were.

Results

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 ROV. The samples were frozen at -20°C and fixed for further treatment. Plume samples were taken using the CTD. These samples were filtered and immediately frozen at -20°C or fixed for further processing. A microbiological sample list is shown in the Appendix 7.

b) The samples mentioned above were also used for obtaining enrichment cultures. For these purposes 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 laboratory at home with the aim to obtain pure cultures.
In cultures that were enriched with hot hydrothermal vent fluid hyperthermophilic microorganisms were observed (Fig. 2.29). They grew at 92°C on acetate with hydrogen and iron(III).

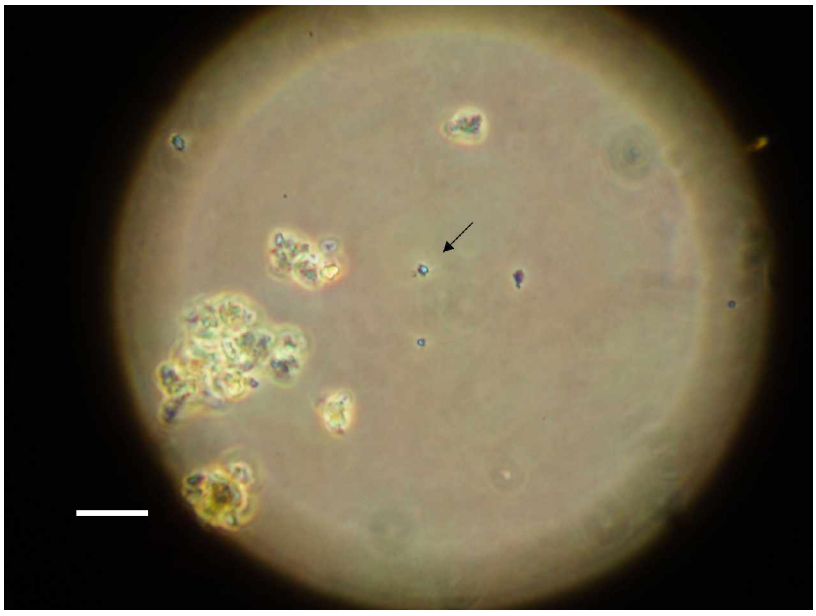


Fig. 2.29: Microscopic picture from hyperthermophilic microorganisms in culture. The sample originates from hot hydrothermal vent fluid. This microorganism grows on acetate with hydrogen and iron at 92°C. Scale bar 10µm.

c) Microscopic observations of microorganisms inhabiting freshly taken samples revealed heterogenous morphotypes. A white “microbial mat” (Fig. 2.30A) with shimmering water was discovered between IRINA II and site “B” (257ROV). Microscopic observations

revealed that the white flocs observed are not microorganisms but substrate to which filamentous bacteria are attached to (Fig. 2.30B).

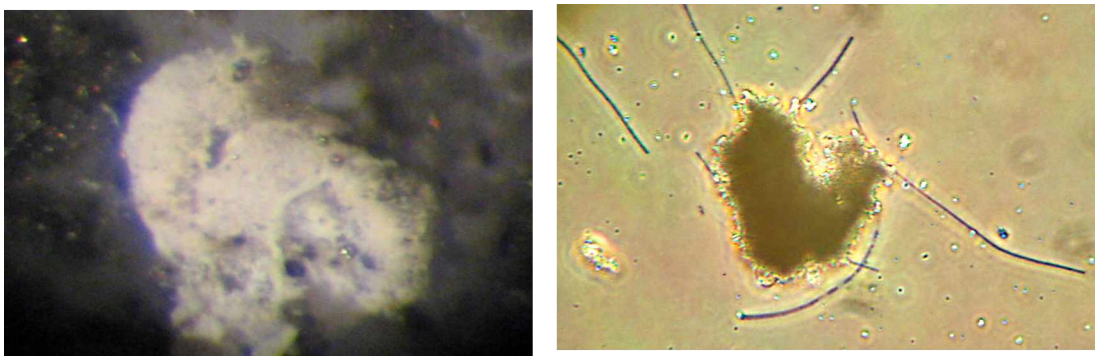


Fig. 2.30: Pictures showing the “microbial mat” positioned between IRINA II and site “B” (257ROV). (A) Stereo microscopic picture of white “microbial mat” (scale bar 2mm) and (B) showing the attachment of filaments to the white floc (scale bar 10µm).

Further microscopic analysis revealed that these filaments consist of single bacteria chained together (Fig. 2.31A). This sample generally exhibited heterogenous morphotypes of microorganisms such as cocci, rods, or spiril shaped ones. Grey sediment collected from the border of the IRINA I crater (252ROV-4) showed amongst rods and cocci also morphotypes resembling spirochaetes (Fig. 2.31B).

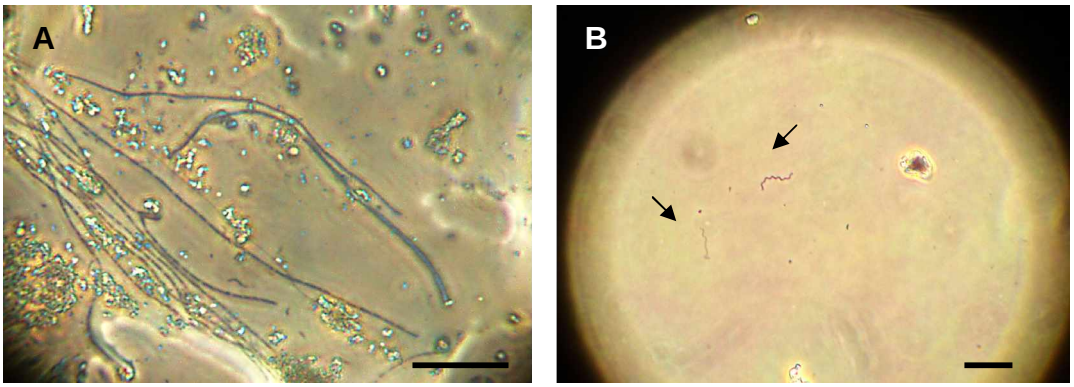


Fig. 2.31: (A) Microscopic picture from the “microbial mat” showing filaments comprising single bacteria chained together (scale bar 10µm)**.** (B) Microscopic picture from grey sediment collected from the outer rim of the IRINA I crater (252ROV-4) showing spirochaetes (scale bar 10µm).

2.4.9 Hydrothermal symbioses

(N. Dubilier, F. Zielinski)

Our main goal for this cruise was to investigate the transfer of energy from vent fluids to the dominant members of the faunal community at Logatchev, the mussels *Bathymodiolus puteoserpentis*. These mussels have greatly reduced guts, and their main source of nutrition are symbiotic bacteria that live in their gills. Two types of symbionts coexist in the gill cells: thiotrophic bacteria that use reduced sulfur compounds such as sulfide as an energy source and fix CO_2 as a carbon source, and methanotrophic bacteria that use methane as both an energy and carbon source. The energy sources for the mussel symbioses are delivered by the hydrothermal fluids that carry high concentrations of sulfide, methane, and other reduced compounds. The dilution of these effluents with ambient seawater leads to gradients in sulfide and methane concentrations that vary over time and space. These gradients play a major role in determining the biomass, activity and productivity of the vent community. We have defined these interactions between hydrothermal and biological processes as the geobiological coupling between vent fluids and symbiotic primary producers.

During this cruise, we contributed to our ongoing studies of geobiological coupling at MAR vents by identifying and characterizing gradients in vent fluids in mussel beds, and collecting mussels along these gradients for analysis of the biomass and activity of the bacterial symbionts. To collect geochemical data at a scale relevant to the mussel community, we worked in close collaboration with the fluid chemistry group, temperature logger group, and in situ group on mussel beds from three sites at Logatchev, two sites at IRINA II and one at QUEST. Site 1 at IRINA II was located relatively high on the IRINA II mound, close to the active black smokers on top of the IRINA II complex. This site was completely dominated by *Bathymodiolus* mussels that formed a dense bed of several layers thickness with no empty shells visible. Site 2 was lower on the IRINA mound, south of the large chimney complex, and close to the small active black chimney. At this site, 2 mussel beds separated by only a few meters were sampled: the mussel bed at Site 2A appeared less active with many empty mussel shells and high abundances of gastropod snails and ophiurid sea stars covering the mussels, which were rusty brown in color. In contrast, the mussels at Site 2B appeared to be thriving, with little coverage by other animals, and the mussel shells shiny dark-brown to black in color. Site 3 at QUEST was a mussel bed located southeast of the active smoker at QUEST. This site was characterized by high abundances of juvenile mussels. Shimmering water was observed at all collection sites, and shrimp were regularly observed at the bottom layers of the mussel beds. A summary of collections sites and geochemical data is provided in Table 2.5.

A further major goal during our cruise was to study how the removal of mussels from fluid gradients affects the symbiosis. In a so-called transplant experiment, we collected mussels at Site 1 on the IRINA II complex and placed them at a site far removed from any obvious vent fluids (Beacon 14, Fig. 2.32).

Mussels were collected using the ROV manipulator arm in nets (40 cm length with a 20 cm diameter opening, mesh size 1000 µm) with a net-covered lid that could be closed after collecting the mussels, to prevent predators such as vent crabs from entering the nets or mussels from escaping from the nets. Nets were recovered from the Beacon 14 site 1, 2, 5,

7, and 10 days after collection at Site 1 and prepared on board for morphological and molecular analysis in the home laboratory. For on board analysis of methane oxidation rates, gill tissues were incubated in radioactive methane for up to 8 hours and the decrease in methane in the incubation over time determined in collaboration with Janine Felden (MPI-Bremen) from the in situ group (Fig. 2.33). No significant decrease in methane oxidation rates occurred for up to 2 days after removal of the mussels from vent fluids, but after 5 days, methane oxidation rates decreased by at least 60%. This indicates that the symbionts are not digested by the mussels and remain fully active during the early stages of starvation, but become less active during the later stages of starvation, possibly because of partial digestion by their hosts. Our home laboratory analyses will show if this assumption is supported by morphological and molecular data.

Table 2.5: Mussel collection sites and corresponding in situ, temperature, and fluid data.

site	location	purpose	mussel sample	Profiler data	temperature data		fluid data				
				station number	station number	logger #	station number	$[CH_4]$ [µM]	$[H_2]$ [µM]	$[S^{2-}]$ [µM]	[pH]
1	**IRINA II mussel bed**	mussel transplantation experiment	**252 ROV/6** (0 days) **244 ROV/7** (1 day) **244 ROV/6** (2 days) **244 ROV/8** (5 days) **244 ROV/9** (7 days) **244 ROV/10** (10 days)	232 ROV/4(a) 244 ROV/1	249 ROV/1 249 ROV/2 249 ROV/3 249 ROV/4 249 ROV/6 257 ROV/1	online online online online 4143 0-9	232 ROV/7	**3,06**	**5,44**	max. 0,4	7,86
2A	**IRINA II mussel bed**	mussel collection	**232 ROV/5**	232 ROV/1	232 ROV/4 232 ROV/6	online 4144	232 ROV/3	**1,63**	**1,36**	max. 0,16	7,92
2B	**IRINA II mussel bed**	mussel collection	**266 ROV/7**	266 ROV/1 266 ROV/2 266 ROV/3 266 ROV/4 266 ROV/5 277 ROV/?	None		266 ROV/6	**15,04**	**5,89**	6	7,63
3	**QUEST mussel bed**	mussel collection	**281 ROV/3**	None	281 ROV/4	10-19	281 ROV/2	**63,68**	**4,20**	70	6,97
-	**IRINA II near dome structure**	shrimp collection	**272 ROV/6**	None	None		None				
-	**IRINA II near dome structure**	shrimp collection	**283 ROV/7**	None	None		None				

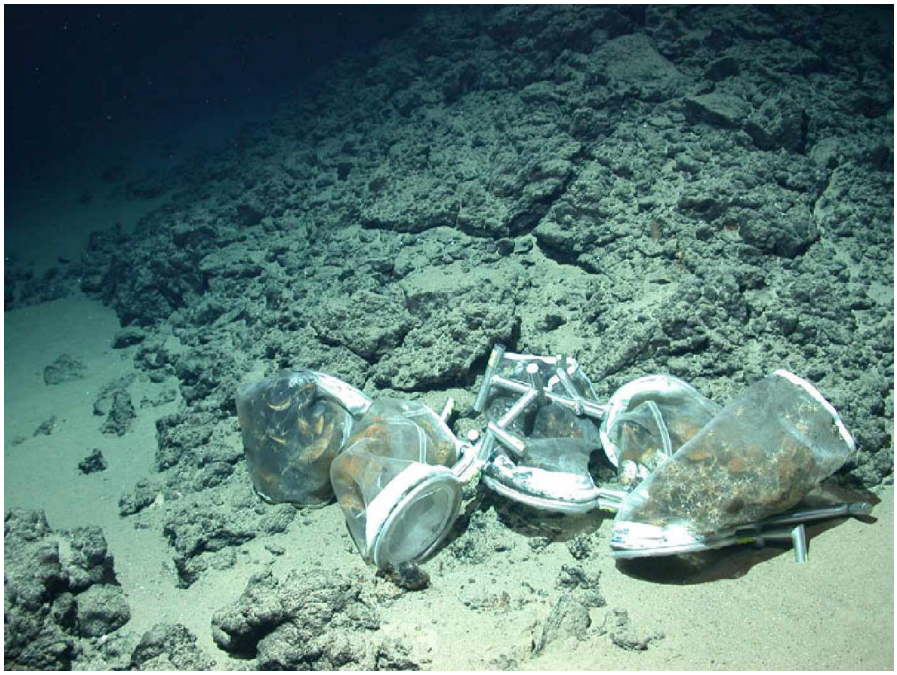


Fig. 2.32: Site at Beacon 14 where mussels were transplanted from Site 1 on the IRINA II complex to remove them from hydrothermal activity.

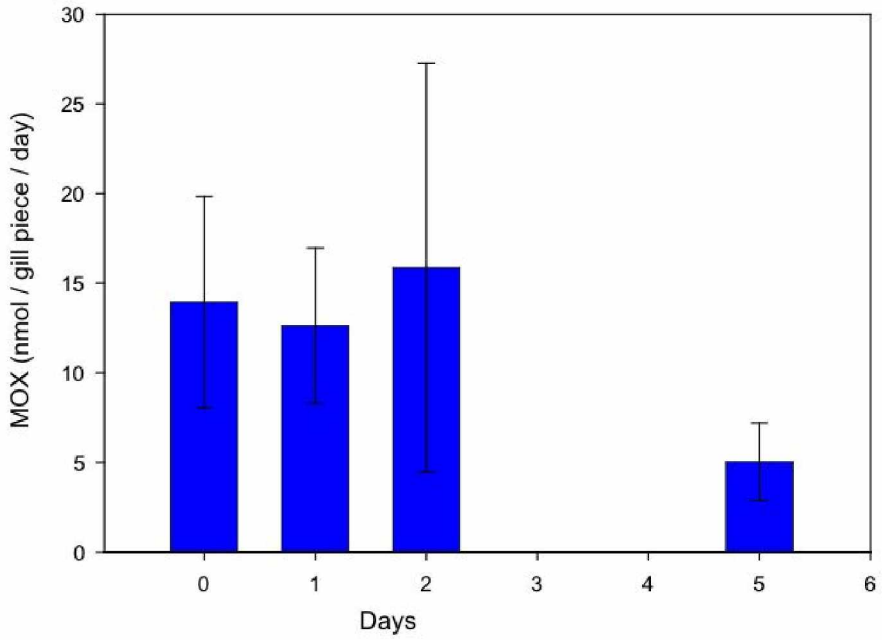


Fig. 2.33: Oxidation rates of methane in gills of *Bathymodiolus puteoserpentis* mussels removed from vent fluids for up to 5 days. Data for 7 and 10 days is currently being analysed.

In addition to our studies on the *Bathymodiolus* mussels, shrimp were collected from the IRINA II chimney complex, using the nets described above and the ROV manipulator arm. After recovery, the shrimp were stored in chilled sea water for up to 4 hours before specimens belonging to the genus *Rimicaris* were dissected and fixed on board for analysis in the home laboratory. The symbionts of these shrimp, that are abundant on their appendages and in their gill chamber, will be investigated using morphological and molecular

techniques. Attempts to collect live vesicomyid clams that reportedly occur in the vicinity of the ANYA marker were not successful, and only empty *Bathymodiolus* shells were found in our collection nets. Live thyasirid clams, of which only a few specimens were found in the ANYA area during the last HYDROMAR cruise, were not observed during this cruise.

2.4.10 Fluid dynamic and microbial processes

(F. Wenzhöfer, J. Felden, M. Viehweger)

The main goal of this study was the investigation of physico-chemical gradients at water-substrate interphases and microbial processes at selected habitats. *In-situ* microsensor measurements of O_2, pH, H_2S, T and, for the first time, H_2 were used to investigate the links between the geochemical energy supply from hydrothermal fluids and hydrothermal vent communities. These high-resolution microprofiles allow to determine the variability of hydrothermal fluid emission in space and time and its influences on vent communities. With the aid of such fluid analyses (together with fluid sampling), habitats were selected for studying microbial turnover rates of methane, CO_2 fixation and thymidine incorporation.

Profiler and benthic chamber deployments

To investigate the small scale fluid dynamics at vent mussel fields two benthic lander modules, a profiler and a chamber, have been constructed to be deployed and operated by the ROV. The autonomous profiler module (Fig. 2.34; Wenzhöfer et al., 2000) hosted 2

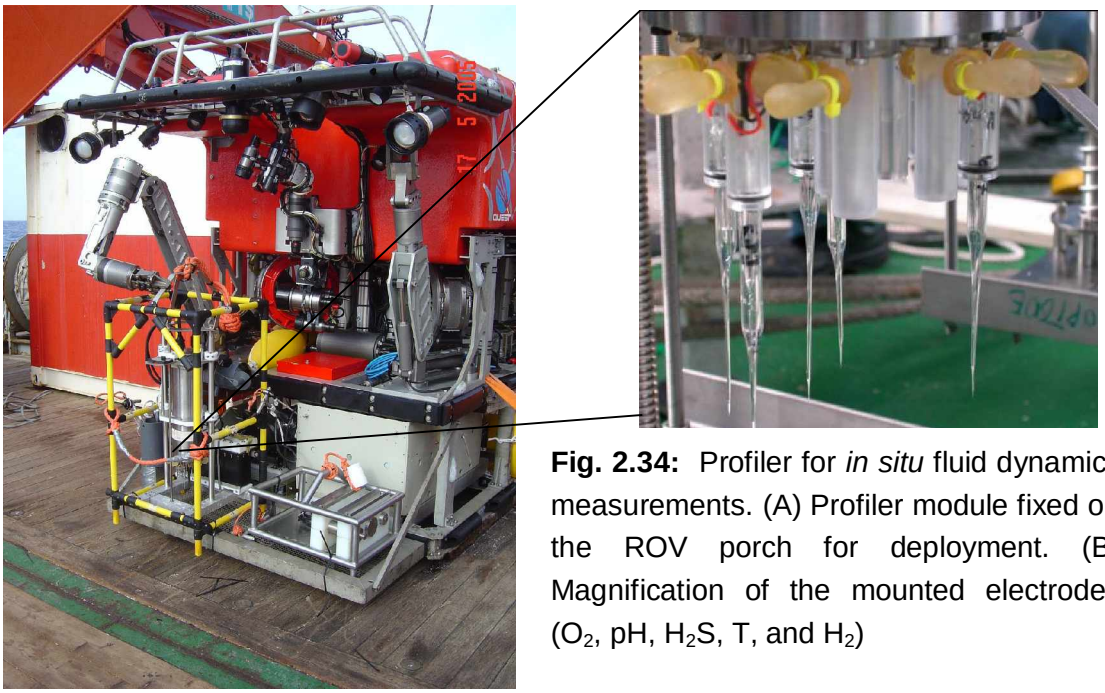


Fig. 2.34: Profiler for *in situ* fluid dynamics measurements. (A) Profiler module fixed on the ROV porch for deployment. (B) Magnification of the mounted electrodes (O_2, pH, H_2S, T, and H_2)

O_2, 1 temperature (Pt100, UST Umweltsensortechnik GmbH, Geschwenda, Germany), 2 pH, 3 H_2S and for the first time 1 H_2 microelectrodes (UNISENSE, Denmark). If not specifically mentioned all electrodes have been constructed in our laboratory in Bremen. During the

deployments measurements were taken every second to study the short-time variations within diffuse fluid fluxes above a mussel bed (Fig. 2.35).

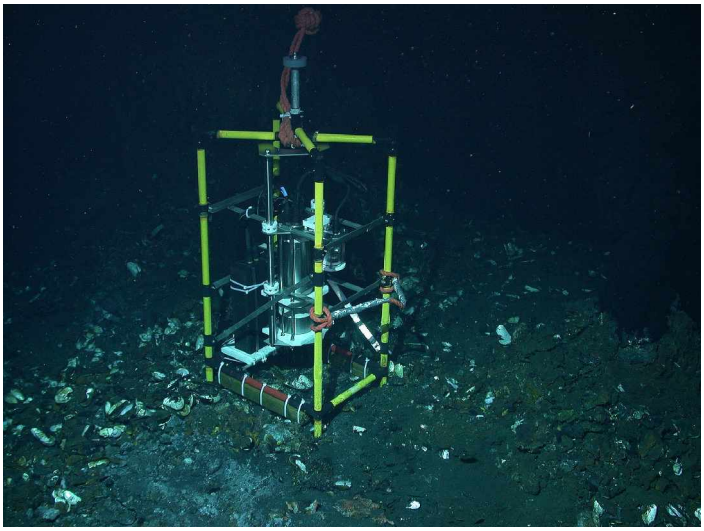


Figure 2.35: Profiler placed on a mussel bed at IRINA II.

The benthic chamber module is a modified version of the free-falling chamber lander previously used to study benthic processes in the deep-sea (Wenzhöfer and Glud, 2002). This small benthic module consists of a circular chamber, an electronic cylinder, a water sampling system and a battery which can be operated by the ROV. The chamber encloses an area of ca. 285 cm^2 together with 15 cm of overlying bottom water. Two microelectrodes (1 H_2S and 1 H_2) mounted in the chamber lid monitor the concentration change in the enclosed water body while at preprogrammed time intervals 5 water samples (each 50 ml) were retrieved for later analyses of O_2, DIC and other elements.
All in situ measurements were performed at IRINA II along a gradient of different diffuse fluid flows (Tab. 2.6).

Microbial activity measurements
Rates of aerobic methane oxidation, chemoautotrophic production (CO_2 fixation) and bacterial growth (Thymidine incorporation) were measured on hot and diffuse fluid samples taken by the ROV (Niskin bottles mounted on the tool sledge and fluid sampling system) and CTD-Rosette (Tab. 2.6). Samples were processed directly after the recovery of the sampling devices or stored shortly at 4°C. After adding the tracer, all samples were incubated for 6 hours to 5 days at 4, 20, 60 and 80ºC, respectively. Activity was counted in degassed samples on a liquid scintillation counter. Rates of aerobic methane oxidation, CO_2 fixation and Thymidine incorporation will be calculated back home after determining the dry weight of the incubated biomass, the dissolved inorganic carbon concentration in the fluids and the tracer activity.
Additionally microbial rate measurements and incubation experiments were carried out on mussel gills, sediments and rock particles.

Preliminary results

All electrode signals showed a highly fluctuating signal over time when placed on a diffuse venting mussel bed. However, the maximum signal change varied within the same mussel field on a distance of a few decimeters. As an example temperature signals from 4 different sites from a mussel bed at IRINA II are shown in figure 2.36. The ambient temperature of the bottom water was 2.6ºC while the maximum temperature above a mussel bed with visually shimmering water was 6.5ºC. At occasions where warmer fluids pour out electrode signals of H_2S and H_2 increased while O_2 electrodes showed a distinct reduction. The exact concentration changes will be calculated back home, after analyzing the calibration solutions. All electrode signal readings, however, revealed a highly dynamic diffuse fluid venting with space and time.

Table 2.6: Overview of sampled stations for Profiler and benthic chamber deployments, aerobic methane oxidation (MOx), chemoautotrophic production (CO_2 fixation) and bacterial growth rates (Thymidine incorporation).

Station	Profiler	Chamber	MOx	CO_2 fixation	Thymidine incorporation
217 CTD			X	X	X
232 ROV	X				
	(2 sites)				
242 CTD			X		
244 ROV	X				
249 ROV			X		
257 ROV			X	X	X
266 ROV	X		X		
	(5 sites)				
270 CTD			X	X	X
272 ROV			X	X	X
277 ROV	X		X		
281 ROV		X	X		
283 ROV			X		

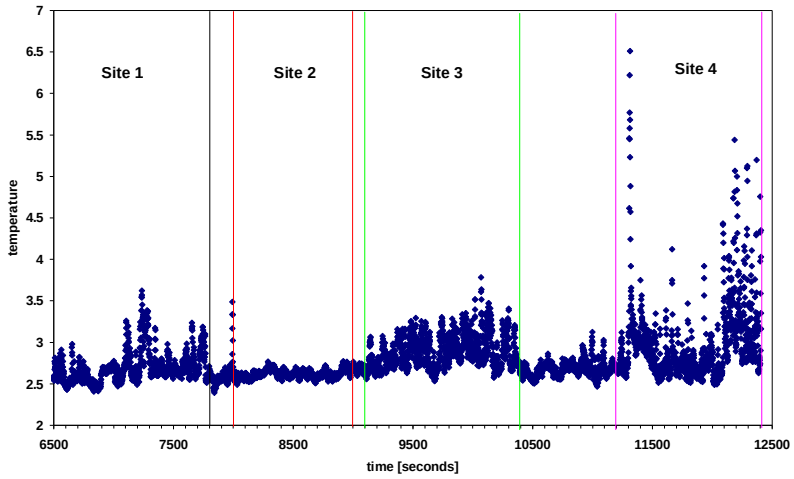


Fig. 2.36: In situ temperature at 4 different sites above a mussel field at IRINA II

2.4.11 Metagenomics

(A. Meyerdierks)

The aim of the participation in cruise M64/2 to the Logatchev hydrothermal field was the sampling of free living microbial communities at few characteristic hydrothermally influenced sites with high biomass for metagenome analyses. Preferred samples were sediments and microbial mats as several grams of a microbial mat or several hundred grams of sediment contain generally sufficient cells for a metagenome study. The samples should be taken in a systematic way, e.g. by the ROV, at well characterised sites.

Methods

Upon retrieval, each sample was divided in several parts. Sediment cores were sectioned into 1 cm or 2 cm slices prior to further treatment. Sediment samples were fixed with 60% ethanol in phosphate buffered saline (PBS) and 2-3% formaldehyde (FA)/PBS, respectively, for cell count determination, and community structure analysis. The major part of the sample was deep frozen for DNA extraction (-20°C) in the home laboratory. Small parts of rocks, crusts and sulfide samples were fixed with 1% FA/PBS for community structure analysis, and the other part of the sample was again deep frozen for DNA extraction. Microorganisms in fluid and plume samples were fixed with 1% FA/PBS or left untreated prior to a concentration of the cells on polycarbonate membrane filters (0.22 µm) or in a Sartobran 300 filter unit.

Samples and Preliminary Results

Samples were taken at different characteristic sites by the ROV, the CTD-rosette sampler, and the TV-grab, and included the following material:

1) Two sediment cores were taken in an area exhibiting a white surface, close to the “marker Anya” (263ROV, Fig. 2.37a and b). Temperature measurement by the environmental parameters group (2.3.5) revealed 52°C at a depth of about 25 cm below seafloor. The analysis of fluid, taken with Niskin bottles above this site, by the gas chromatography group (2.3.6), indicated elevated methane and hydrogen values. The sediment had a sulfidic smell.
   Additionally, a sediment core (20 cm) was taken close to the mussel bed found in the QUEST area at a side also covered with a white film (283ROV).
2) Other sediment samples (5 stations) were taken by the TV-grab (229GTV, 239GTV and 250GTV), or sampled, together with mussels, in a net taken at QUEST (281ROV). One sediment sample was collected 88 m south of IRINA II at a field, again covered with a white film, using a shovel with lid (252ROV, Fig. 2.37c). Here, the temperature on top of the sediment was about 27°C, determined by the environmental parameters group (2.3.5). Shimmering water was observed, and microscopic analysis by the microbiology group revealed a diverse microbial community supposedly associated with the white matrix (see chapter 2.3.8).

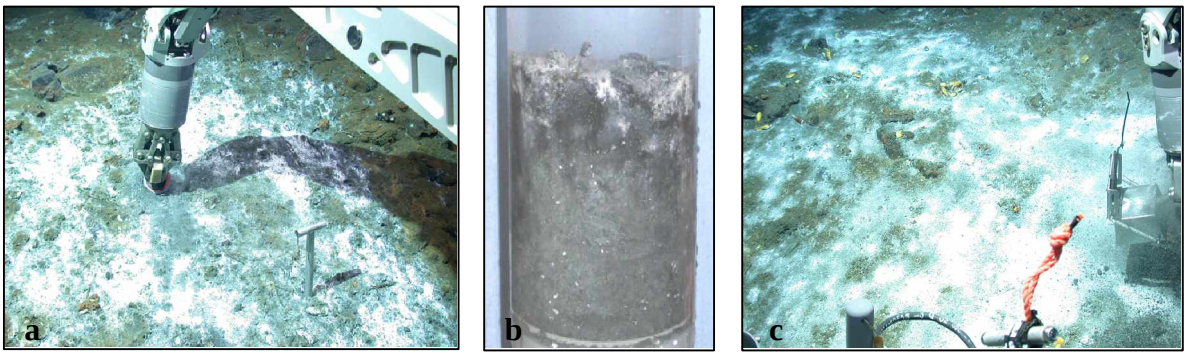


Fig. 2.37: a) Sampling of sediment cores with a push corer and temperature measurement at a field exhibiting a white surface layer close to the marker “Anya”. b) Sediment core before sectioning. c) Sampling of sediment with the shovel, south of IRINA II.

3) Sulfide structures, crust and rock samples (8 stations) were collected by the gripper of the ROV, and found in TV-grab contents and nets after mussel sampling.
4) Hydrothermal fluids were obtained using Niskin bottles (6 stations) or by participating in the fluid sampling system (chapter 2.3.7; 4 stations). Up to 6 l diffuse flow, sampled with Niskin bottles, and up to 1.4 l derived from the fluid sampling system were filtered for DNA extraction. Two samples were derived from a black smoker (261ROV).
5) Hydrothermal plume (2 stations) was collected using the CTD-rosette sampler. About 42 l of hydrothermal plume from 242CTD (water depth 2770 m) and about 79 l of plume sampled during 270CTD (water depth 2800) were filtered for DNA extraction.
6) Finally, mussel byssus and its associated microbial community (2 stations) was sampled by scraping byssus from mussel shells (232ROV, 281ROV).

2.4.12 Marine zoology

(J. Stecher)

Zoological samples were taken at 36 stations, representing 7 hydrothermal active sites and 8 non hydrothermal active locations (see Appendix 8).

The Smoker-Complex and Chimney Habitat

The highest biodiversity was observed at the IRINA II site. Three of the chimneys, characterised by shimmering water, were covered by *Bathymodiolus puteoserpents*, whereas only one was dominated by dense shrimps-aggregations of *Rimicaris* cf. *exoculatus* (Fig. 2.38). Additionally *Chorocaris* and *Mirocaris* were observed here. At this chimney the fluids showed maximum temperatures of 170°C (277ROV, 283ROV). Obviously those shrimps were clearly less abundant at the small separate smoker on the southern end of the smoker-complex. Here the fluids showed maximum temperature of 225°C (224ROV).

Concerning the distinct patched settlement of different species at chimneys one remarkable feature is worth while to mention. The northern chimney was clearly separated into two sections, the side, facing to active venting was covered by dense aggregation of *Bathymodiolus puteoserpents* whereas the far side was only overcast with clutches of gastropods (Fig. 2.39).

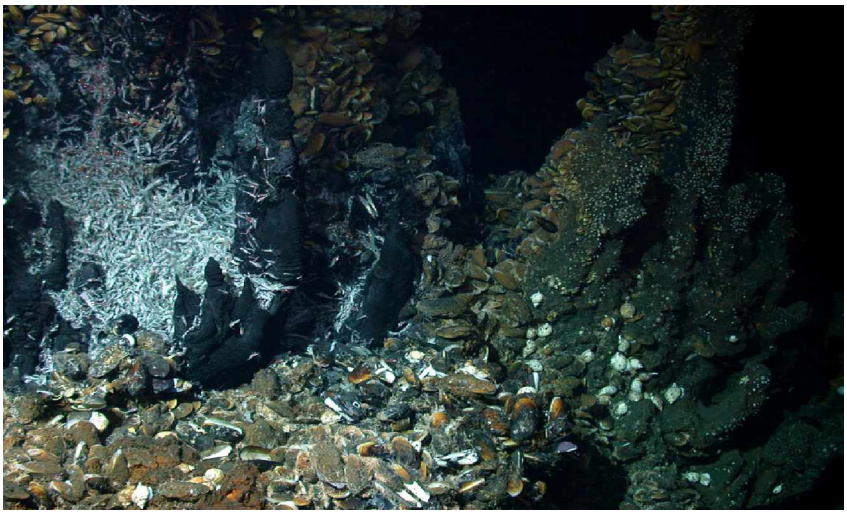


Fig. 2.38: The “Shrimps gap” and the northern chimney (right) at the E-wall of the smoker-complex at IRINA II.

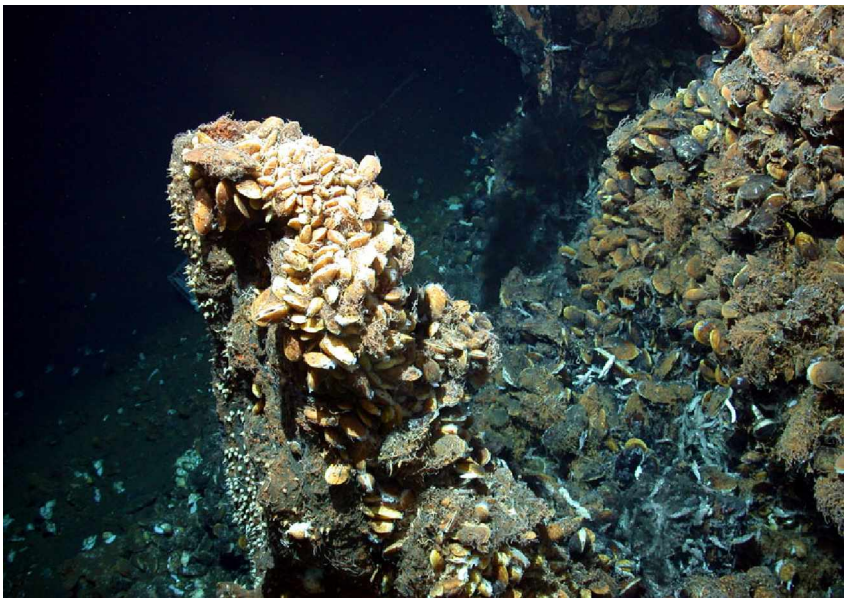


Fig. 2.39: Northern chimney of the smoker-complex of IRINA II: One half covered by *Bathymodiolus puteoserpentis* facing towards active venting, and the far side only spread by clutches of gastropods.

In the western forefront of the smoker-complex we found a well established *Bathymodiolus puteoserpentis*- association. Its length-width dimension was approximately 4m x 3m. In comparison with the mussel association of the smoker-complex this assemblage showed own characteristics based on its accompanied fauna. The brittle starfish *Ophioctenlla acies* and the snail *Phymorhynchus* cf. *moskalevi* were clearly more abundant in the forefront assemblage as thus at the smoker-complex itself. Dense aggregation of shrimps, comparable to those of the smoker-complex were absent. Specimen of *Alcinocaris* and *Mirocaris* were more frequently observed here. They inhabited the mussel field in slightly abundances between the mussels. Additionally chaetopterid,and terebellid annelidsas well as *Archinome* c.f. *rosacea* lived within the byssus of *Bathymodiolus puteoserpentis*. The vent endemic fish *Pachyara thermophilus* was only seen here in the IRINA II site of LHF I. Two more typical species, which belong to the accompanied fauna were the decapod crustaceans *Segonzacia mesatlantica* and the squat lobster *Munidopsis crassa*. Whereas *Segonzacia mesatlantica* was widely distributed at the smoker-complex as well on the mussel field, *Munidopsis crassa* was clearly patched. *Munidopsis crassa* was manly observed in inactive regions at the northeast side of the smoker-complex, where an extinct field of dead mussels was located. In contrast *Segonzacia mesatlantica* was observed in the vicinity of shimmering water with temperatures ranging from 3°C to 8°C.

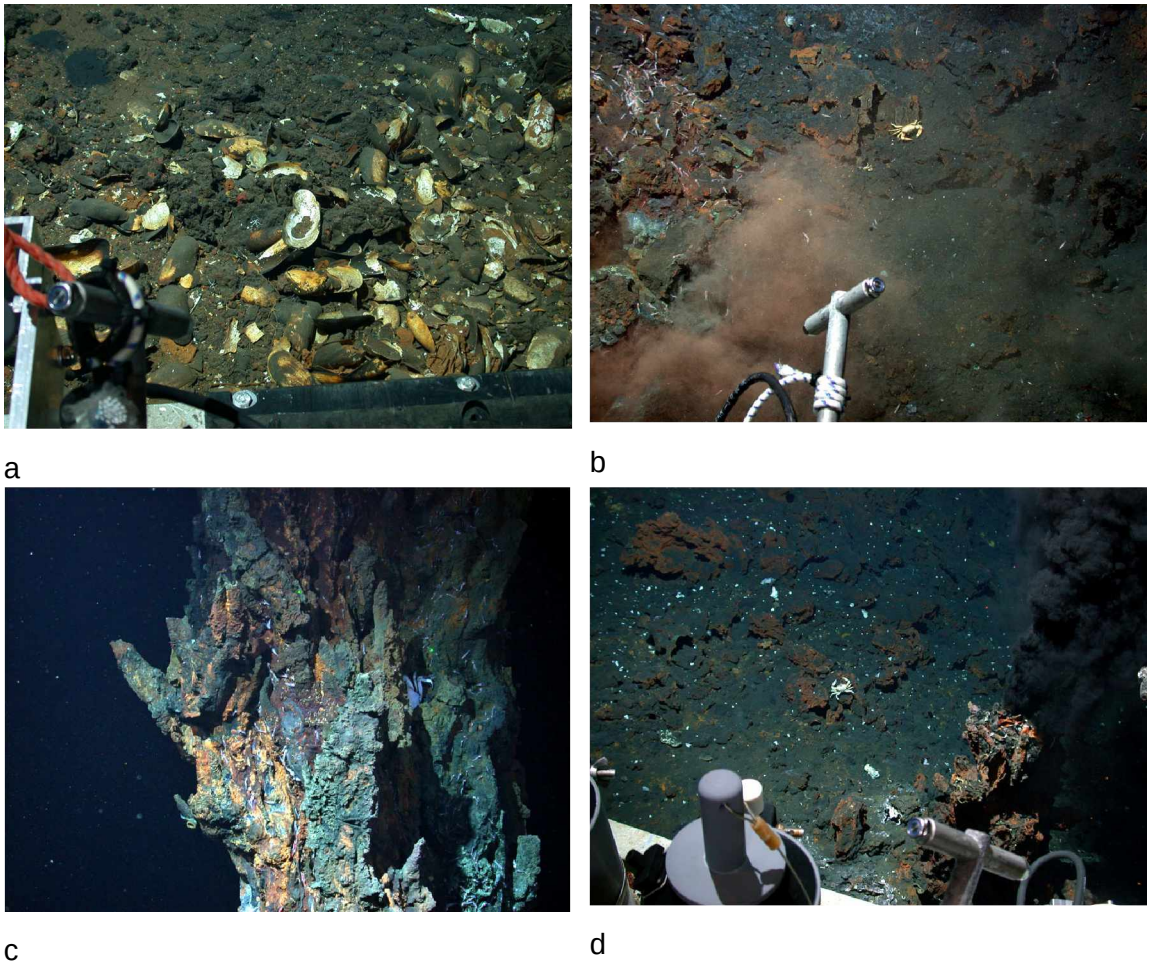
The fauna became impoverished at site “A”. Live specimens were only seen at the single active chimney Barad-Dûr. Single shrimps inhabited the tip region of the chimney where black fluids emerged. Additionally see-anemones (actinaria) were sitting here. Right in the vicinity of emerging fluids specimens of the gastropod *Peltospira smaragdina* were sampled. Those snails were also found at black smokers of IRINA II. Furthermore the vent crab

Segonzacia mesatlantica was seen on flanges in 4-5m height as well at the bottom of the chimney. An expanded mussel field with live *Bathymodiolus* specimens, comparable to this of IRINA II was not found. At the bottom only several actinians were seen.

The "Smoking-Crater"-Habitat

With the exception of the "QUEST" site the biodiversity at the smoking craters was very low, comparable with that of the smoker Barad-Dûr. Only at the little smokers of the crater rim we found a vent fauna, consisting the shrimp *Rimicaris exoculata* and the bythograeid crab *Segonzacia mesatlantica*. In the periphery of the smokers actinaria were regularly observed as well as fishes of the family Bythitidae, mainly *Cataetyx* c.f. *laticeps*. The less abundances of crustaceans were documented at site "B", were we measured the highest fluid temperatures with 300°C up to 350°C. At "IRINA I", where the temperatures of fluids were significantly lower (177°C) shrimps and crabs were more abundant. On the other hand actinians were obviously more abundant in the vicinity of smokers at site "B" (Fig. 2.40).

Live *Bathymodiolus puteoserpentis* mussels patches we found only in the "QUEST" site. One major patch, which was accurate investigated covered an area of 3m x 1m. These assemblage was characterised by juveniles mussels. They covered not only the float of at the temperature logger No3, which was left back on Meteor cruise M60/3, additionally we found them living among adults within the mussel field. This indicated that recruitment processes were successful during the last one and a half year. The accompanied fauna was similar with those of the "IRINA II" mussel field. Only *Phymorhynchus mosalevi* was less abundant at the "QUEST" site. The temperature of its diffuse fluids exceeds not over 12 °C. Therefore the diffuse fluids were slightly wormer than those of the mussel field of "IRINA II". Whereas the major mussel patch was approximately 3m away from the cater rim, several much smaller mussel patches (20-30cm in diameter) were located in the vicinity of little active smokers directly at the crater's rim. Comparable distribution patterns of patched mussels we also found in "IRINA I". Unfortunately the *Bathymodiolus*-population was dead, only some live specimens were noticed at the bottom of the active smokers at the crater's rim (Fig. 2.40).



a b c d

Fig. 2.40: Assemblages at different habitats of LHF I: Shells of dead *Bathymodiolus* specimens of IRNIA I (a), shrimps, *Segonzacia mesatlantica*, and a single actinia at ANNA-LOUISE (b), Barad-Dûr of site “A” inhabited by shrimps and *Segonzacia mesatlantica* (c), little actinians and *Segonzacia mesatlantica* at site “B” (d).

Size-Frequency Distributions of Bathymodiolus puteoserpentis

During the transplantation experiment 6 nets were collected, laid beside the mussel field and recovered after a fixed time schedule (see 2.3.9 hydrothermal symbiosis). One more net was excluded for the experiment, because its recovery exceeded the time schedule. All *Bathymodiolus* specimens were shipboard measured and length were used for size-frequency analysis. Hence to the transplantation experiment 243 *Bathymodiolus puteoserpentis* specimens were measured. Additionally 61 specimens were retrieved from the same mussel field by two samples (232ROV-5, 266ROV-7), 5m away from the transplantation experiment spot, nearby the T-logger # 4 from the Meteor cruise M60/3 (Tab. 2.7, Fig. 2.41, Fig. 2.42). These samples are comparable with the station 38ROV-4, taken on M60/3.

Table 2.7: Samples used for size-frequency analysis of *Bathymodiolus* puteoserpentis, retrieved from the mussel-field IRINA II.

Station	total number of *Bathymodiolus puteoserpentis*	Location
244 ROV# 6, Net No 6	54	"IRINA II" mussel-site 2 (transplantation-experiment), northern end of the field
244 ROV# 7, Net No 4	37	
244 ROV# 8, Net No 2	34	
244 ROV# 9, Net No 8	38	
244 ROV#10, Net No 10	22	
252 ROV# 6, Net No 9	66	
232 ROV# 5	18	"IRINA II", mussel-site 1, southern end of the field
266 ROV# 7	43	
Total number	304	

Additionally four more nets of *Bathymodiolus* were taken. One at the E-wall of the smoker-complex (277ROV-6), and three at the "QUEST"-site (263ROV-6, 281ROV-3, 285ROV-5). Only those animals (126 individuals) were shipboard measured, which were chosen for molecular biological studies. Detailed statistics will follow in the institute's lab.

The size-frequency distribution within the mussel field of "IRINA II" showed clearly one broader peak of mussels from 6cm up to 11 cm length. Within the population at the northern end of the field one more little peak is obviously. It consists of young mussels which did not exceed a length of 4cm. These distribution patterns indicated, that recruitment processes were successfully in the past. Additionally the mortality seemed to be relative low, because only one slightly peak of dead shells was noticed.

Nevertheless it seemed to be that recently recruitment processes were severely limited over the last year, since the T-logger # 4, which was placed during Meteor cruise M60/3, was not overgrown by any Bathymodiolus specimens. For comparison, the growth of young mussels at T-logger # 3 of the "QUEST" site indicated that recently recruitment processes are still active.

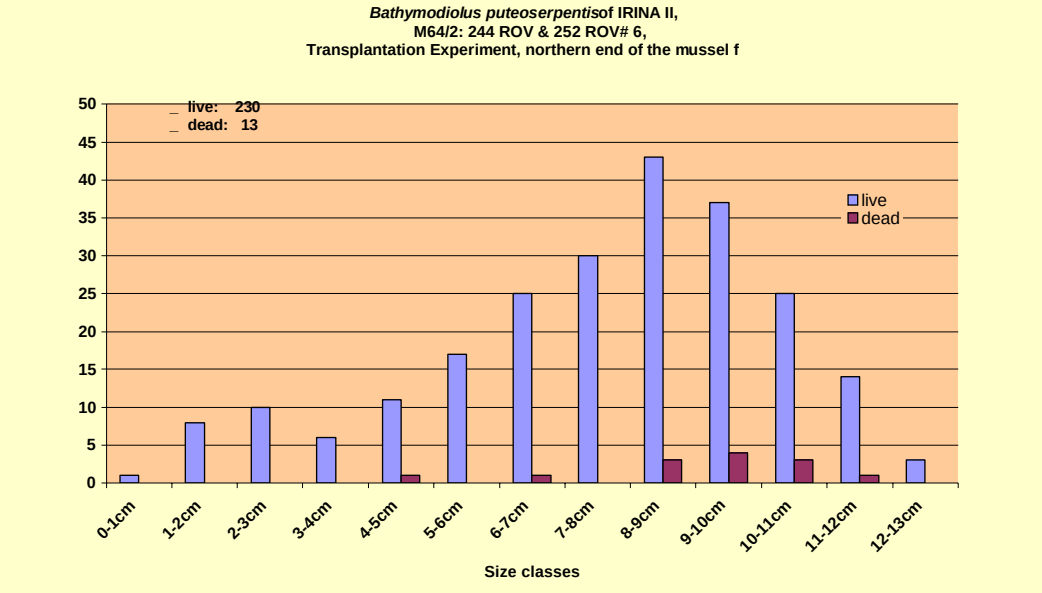


Fig. 2.41: Size-frequency distribution of *Bathymodiolus puteoserpentis* at the northern end of the mussel field in IRINA II during Meteor cruise M64/2.

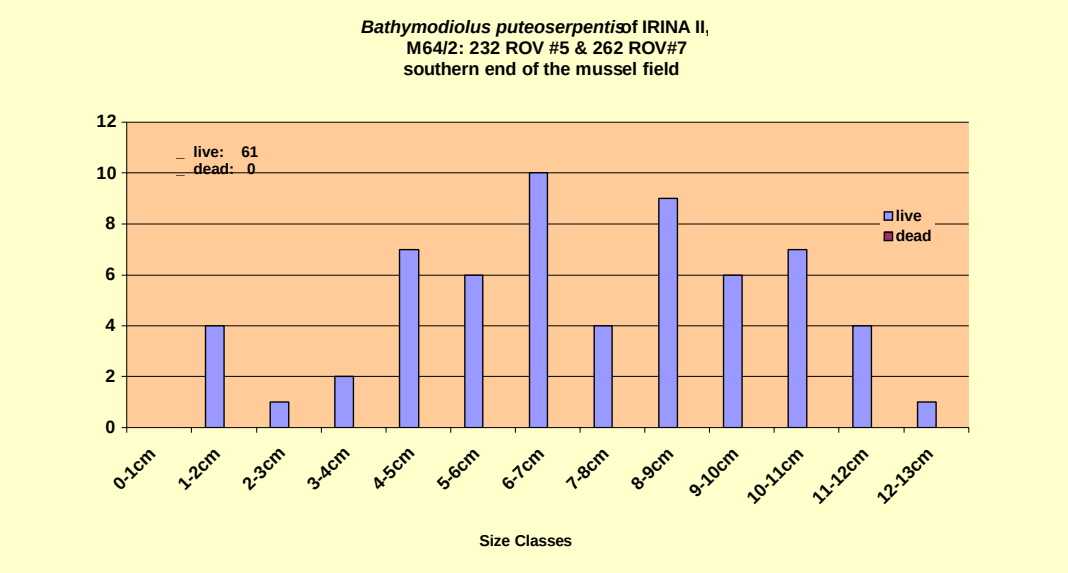


Fig. 2.42: Size-frequency distribution of *Bathymodiolus puteoserpentis* at the southern end of the mussel field in IRINA II during Meteor cruise M64/2

"ANYA GARDEN"

Kuhn et al. (2004) described the disagreement between the positioning of "ANYA´S GARDEN" given by Gebruk et al. (2000) and their results during the HYDROMAR I cruise of M60/3. It can be stated as save that the maker "ANYA" is located 30 m northwest of the "IRINA II" site. Starting at this maker, and going the slope upwards to east, we found during our station 263ROV several structures like *Bathymodiolus* patches with shimmering water, microbial mats and several outcrops, which were in agreement with the Gebruk´s description of "ANYA´s GARDEN" (Fig. 2.43). Nevertheless live vesicomyid and thyasirid clams we did not noticed here. Vesicomyid shells we retrieved only at station 258GTV, approx. 20m N of "IRINA II" (see chapter 2.3.1; Fig. 2.2). Because during Meteor cruise M60/3 shells of vesicomyid and thyasirid clams were documented nearby this slope, it seemed to be that changes happened, which we could not interpret at this state of knowledge. Instead of this we flew at the slope over large mussel fields consisting of dead *Bathymodiolus* shells, which were inhabited by the snail *Phymorhynchus moskalevi* as well by the squat lobster *Munidopsis crassa*. Here we observed the most *Munidopsis* at LHF-1 especially on outcrops. So we are sure, that the position of "ANYA´s GARDEN" given by Gebruk et al. (2000) is incorrect. "ANYA´s GARDEN" is located at a slope northwest of the "IRINA II" site and hence to the ecofaunistical results it can be regarded as the north-western branch of "IRINA II".

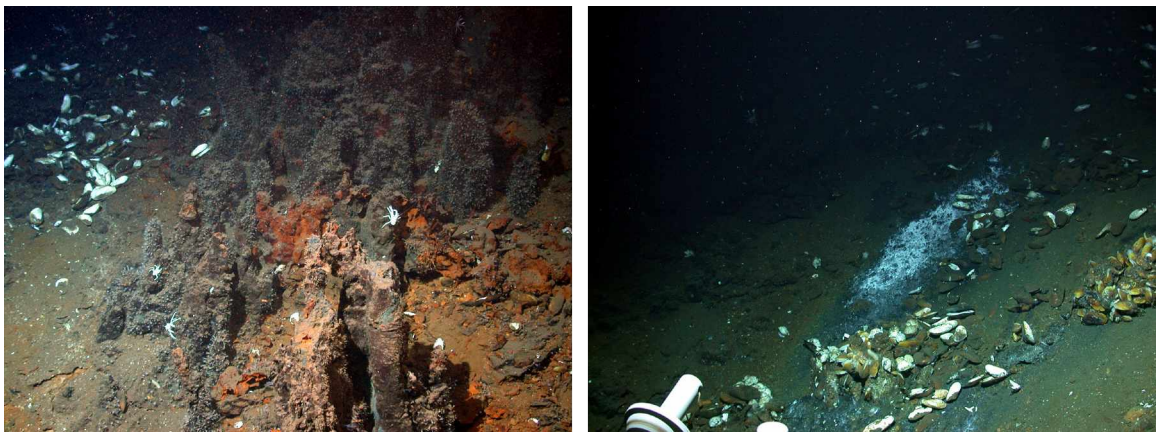


Fig. 2.43: Slope northwest of the "IRINA II" site, possible "ANYA`s GARDEN". Left: Dying mussel population with single outcrop settled by *Munidopsis crassa*. Right: Microbial mats with live *Bathymodiolus puteoserpentis* patches.

2.5 Weather conditions

(W. T. Ochsenhirt)

In the afternoon of May 06 2005 FS METEOR left the port of Fortaleza for leg M64/2. The weather to the beginning of the voyage was dominated by a ridge of a subtropical high in the Southwest Atlantic and METEOR encountered south-easterly trade winds of 4 to 5 Bft.
One day later, in the early morning, near 01° South a first larger cloud belt associated with showers was passed.
On the next day METEOR crossed the ITCZ (**I**nter **T**ropical **C**onvergence **Z**one) accompanied by frequent and heavy showers and gusty winds up to Bft 6 from variable directions. The normal wind direction outside of the tropical shower area was southeast at first and became east to northeast later. Wind speeds without disturbances ranged from 4 to 5 Bft.
The northern edge of the ITCZ extended from 08°N 15°W to 07°N 38°W during this period.
METEOR arrived in the area of investigation near 14,8°N 45,0°W on May 10 in the afternoon. This region was still under the influence of the tradewindsystem and steady easterly winds of 4 to 6 Bft predominated with most frequent wind speed of Bft 5.
On some days the wind decreased to Bft 3. During the whole time of station work the weather was mostly fair with only few periods of light precipitation.
The swell came from easterly directions with height of 1.5 to 2 m, in cases of two swells from different origin up to 3m.
In the evening of May 29 METEOR left the working area with easterly course to Dakar. On the transit the centre of the subtropical high was just south of the Azores. Easterly winds of about 5 Bft backed to Northeast and North and decreased gradually.
In the forenoon of June 04 the voyage ended in the port of Dakar.

2.6 Acknowledgments

We would like to thank Captain Kull and his crew for their professionality and exceptionally hard work during the cruise, which contributed to the success of the expedtion. Furthermore, we acknowledge the professional patronage of the German Ministry of Foreign Affairs as well as Captain Berkenheger at the Leitstelle Meteor.
We wish to thank the German Science Foundation (DFG) for funding the cruise and subsequent analytical work in the framework of the priority programm SPP 1144 “From mantle to ocean: Energy-, material-, and life cycles at spreading axes”.

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APPENDIX

Appendix 1: List of instruments left at the seafloor during M64/2

Appendix 2: List of markers left at the seafloor during M64/2

Appendix 3: Station List

Appendix 4: ROV station protocols

Appendix 5: GTV station protocols

Appendix 6: Fluid sampling list of ROV stations

Appendix 7: List of microbiological samples

Appendix 8: List of zoological samples

Appendix 9: ROV dive protocols

Appendix 10: Detailed maps of ROV tracks

Appendix 1:

Coordinates of instruments left on the seafloor during cruise M64/2

Station#	ID	Date / Time (UTC) of deployment	Coordinates	Water depth	Comments
224 ROV	Beacon # 14	12/05/2005 21:35	14°45.221’ N / 44°58.813’ W	3035 m	Beacon northwest of IRINA II
257 ROV	1-channel T-loggers #1854200 to #1854209	21/05/2005 14:50-16:05	14°45.185’ N / 44°58.748’ W	3036 m	10 T-loggers deployed in the IRINA II mussel field
263 ROV	OBP	22/05/2005 21:35	14°45.221’ N / 44°58.813’ W	3035 m	Ocean Bottom Pressure meter (OBP) deployed close to beacon # 14
272 ROV	BWPM + beacon # 15	24/05/2005 17:10	14°45.071’ N / 44°58.685’ W	2932 m	25 m long Bottom Water Profile Monitor (BWPM) mooring deployed close to beacon # 15
281 ROV	1-channel T-loggers #1854210 to #1854219	26/05/2005 17:00-17:36	14°45.219’ N / 44°58.817’ W	3045 m	10 T-loggers deployed in the QUEST mussel field
283 ROV	8-channel T-loggers #10295 #10298	27/05/2005 16:20-16:35	14°45.219’ N / 44°58.817’ W	3045 m	2 T-loggers deployed in the QUEST mussel field
283 ROV	OBT	27/05/2005 17:51	14°45.221’ N / 44°58.8131’ W	3035 m	Ocean Bottom Tiltmeter (OBT) deployed close to beacon # 14
283 ROV	8-channel T-loggers #10296 #10297	27/05/2005 16:20-16:35	14°45.185’ N / 44°58.748’ W	3036 m	2 T-loggers deployed in the IRINA II mussel field

Appendix 2:

List of markers left on the seafloor during cruise M64/2

Station#	Marker	Date / Time (UTC) of deployment	Coordinates	Water depth	Comments
249 ROV	„M4“	18/05/2005 18:24	14°45.0696´N, 44°58.6963´W	2938m	ANNA-LOUISE
249 ROV	„M5“	18/05/2005 19:01	14°45.0696´N, 44°58.6963´W	2938m	IRINA I
252 ROV	„MB“	19/05/2005 17:26	14°45.1865´N, 44°58.7430´W	3038m	Site A
257 ROV	„MA“	20/05/2005 21:12	14°45.1105´N, 44°58.7024´W	2978m	Site B
261 ROV	„MD“	21/05/2005 19:47	14°45.0805´N, 44°58.7124´W	2949m	IRINA I (ex beacon #11)
281 ROV	„MC“	26/05/2005 20:54	14°45.2166´N, 44°58.8141´W	3040m	QUEST

Appendix 3:

Station List

compiled by Harald Strauss

Station	Area	Location	Depth	Date	Brief description
217-CTD	S of Logatchev	13° 30.00' N 45° 00.00' W	2666 m	10.05.05	Background station for CTD
218-HS	S-N track into LHF-1	13°30'N 45°00'W to 14°30'N 45°00'N		10.05.05 and 11.05.05	Bathymetry
219-CTD	QUEST area	14°45,23'N 44°58,81'W	3017 m	11.05.05	Plume mapping and sampling
220-ROV	LHF-1	14°45,28'N 44°58,85'W	3050 m	11.05.05	Terminated early due to technical problems
221-CTD	S of IRINA II	14°45,11'N 44°58,81'W	3044 m	11.05.05	Plume mapping and sampling
222-GTV	SW of LHF-1	14°44,99'N 44°58,97'W	3075 m	11.05.05	Sampling hydrothermal sediments
223-MAPR	LHF-1	14°45,11'N 44°58,81'W		12.05.05	Plume mapping, 5 MAPR, 20 T-sensors, GAPS, Transponder
224-ROV	QUEST and ANNA LOUISE	14°45,21'N 44°58,81'W and 14°45,21'N 44°58,72'W	3046 m and 3038 m	12.05.05	Deployment of Ocean Bottom Tiltmeter near QUEST area, fluid sampling at ANNA LOUISE
225-GTV	SW of IRINA II	14°45,19'N 44°58,82'W	3048 m	13.05.05	Sampling at future drilling site
226-OFOS	Across LHF-1	14°45,42'N 44°58,38'W to 14°44,86'N 44°59,09'W	2954 m to 3108 m	13.05.05	Mapping along NE-SW profile across LHF-1
227-CTD	NE of Site B	14°45,23'N 44°58,82'W	3020 m	13.05.05	Plume mapping
228-MAPR	W of IRINA II	14°45,11'N 44°58,81'W	3050 m	13.05.05	12 hrs stationary plume mapping with 5 MAPRs and 20 T-sensors
229-GTV	W of IRINA I	14°45,07'N 44°58,72'W	3017 m	14.05.05	Sampling at future drilling site
230-GTV	S of ANNA LOUISE	14°45,00'N 44°58,66'W	2996 m	14.05.05	Sampling at future drilling site
231-CTD	NW of LHF-1	14°45,28'N 44°58,90'W	3038 m	14.05.05	Plume mapping and sampling
232-ROV	IRINA II	14°45,11'N 44°58,81'W	3037 m	14.05.05	Mussel experiment with in-situ Profiler measurements and KIPS fluid sampling
233-CTD	N of LHF-1	14°45,28'N 44°58,76'W	3062 m	15.05.05	Plume mapping
234-CTD	N of LHF-1	14°45,50'N 44°58,76'W	3127 m	15.05.05	Plume mapping
235-CTD	N of LHF-1	14°45,56'N 44°58,82'W	3157 m	15.05.05	Plume mapping
236-CTD	N of LHF-1	14°45,61'N	3155 m	15.05.05	Plume mapping

		44°58,89'W			
237-CTD	N of LHF-1	14°45,77'N 44°58,99'W	3200 m	15.05.05	Plume mapping
238-CTD	N of LHF-1	14°46,02'N 44°59,06'W	3215 m	15.05.05	Plume mapping and sampling
239-GTV	N of IRINA II	14°45,23'N 44°58,75'W	2988 m	15.05.05	Sampling at future drilling site
240-HS	E of LHF-1			16.05.05	Bathymetry across two W-E profiles
241-CTD	N of LHF-1	14°45,82'N 44°58,67'W	3225 m	16.05.05	Plume mapping
242-CTD	N of LHF-1	14°46,01'N 44°58,80'W	3225 m	16.05.05	Plume mapping and sampling
243-HS	E of LHF-1			17.05.05	Bathymetry along S-N tracks
244-ROV	IRINA II	14°45,18'N 44°58,73'W	3032 m	17.05.05	OBT and OBP positioned, biological sampling
245-CTD	N of LHF-1	14°46,00'N 44°59,40'W	3331 m	18.05.05	Plume mapping
246-CTD	N of LHF-1	14°46,40'N 44°59,47'W	3539 m	18.05.05	Plume mapping
247-CTD	N of LHF-1	14°46,60'N 44°59,19'W	3416 m	18.05.05	Plume mapping
248-CTD	N of LHF-1	14°46,09'N 44°59,00'W	3223 m	18.05.05	Plume mapping and sampling
249-ROV	ANNA LOUISE and IRINA I	14°45,05'N 44°58,66'W and 14°45,09'N 44°58,71'W	2950 m and 3034 m	18.05.05	Fluid and rock sampling, mussel nets
250-GTV	S of IRINA II	14°45,16'N 44°58,78'W	3047 m	19.05.05	Sampling at future drilling site
251-CTD	N of LHF-1	14°46,10'N 44°59,16'W	3297 m	19.05.05	Terminated early due to technical problems
252-ROV	Site A and IRINA I	14°45,04'N 44°58,63'W and 14°45,09N 44°58,66W	2928 m and 2992 m	19.05.05	Geological and biological sampling, photomosaicing
253-CTD	N of LHF-1	14°46,09'N 44°59,20 'W	3281 m	20.05.05	Plume mapping and sampling
254-CTD	N of LHF-1	14°45,90'N 44°59,20'W	3248 m	20.05.05	Plume mapping
255-CTD	N of LHF-1	14°45,70'N 44°59,30'W	3180 m	20.05.05	Plume mapping
256-CTD	N of LHF-1	14°45,50'N 44°59,40'W	3157 m	20.05.05	Plume mapping and sampling
257-ROV	IRINA II and Site B	14°45,19'N 44°58,76'W and 14°45,12'N 44°58,70'W	3036 m and 2978 m	21.05.05	T-Loggers, fluid and geological sampling
258-GTV	NW of IRINA II	14°45,21'N 44°58,76'W	3106 m	21.05.05	Geological sampling
259-GTV	QUEST	14°45,23'N 44°58,83'W	3110 m	21.05.05	Biological sampling (GTV empty)

260-CTD	N of LHF-1	14°45,94'N 44°59,06'W	3205 m	21.05.05	Plume mapping and sampling
261-ROV	Site A and IRINA I	14°45,06'N 44°58,64'W and 14°45,09'N 44°58,70'W	2928 m and 2986 m	21.05.05	Fluid and sulphide sampling at Site A, fluid and biological sampling at IRINA I
262-HS	E of LHF-1			22.05.05	Bathymetry along W-E tracks
263-ROV	IRINA II QUEST	14°45,20'N 44°58,76'W	3045 m	22.05.05	Biological sampling, OBT re-positioning
264-CTD	W of LHF-1	14°45,19'N 45°01,02'W	3824 m	23.05.05	Plume mapping and sampling
265-CTD	SW of LHF-1	14°44,00'N 45°00,00'W	3716 m	23.05.05	Plume mapping
266-ROV	IRINA II and Site B	14°45,18'N 44°58,74'W and 14°45,10'N 44°58,67'W	3034 m and 3003 m	23.05.05	Profiler and biological sampling, Fluid sampling
267-CTD	S of LHF-1	14°43,96'N 44°58,97'W	3311 m	24.05.05	Plume mapping and sampling
268-CTD	S of LHF-1	14°44,02'N 44°57.98'W	2952 m	24.05.05	Plume mapping and sampling
269-CTD	S of LHF-1	14°44,00'N 44°57,00'W	2861 m	24.05.05	Plume mapping and sampling
270-CTD	S of LHF-1	14°44,50'N 44°57,70'W	2848 m	24.05.05	Plume mapping and sampling
271-MOOR	SE of IRINA I	14°45,09'N 44°58,69'W	2992 m	24.05.05	Deployment of 25 m of T-Logger Mooring
272-ROV	IRINA II	14°45,08'N 44°58,67'W and 14°45,20'N 44°58,74'W	2984 m and 3046 m	24.05.05	Positioning T-Logger-Mooring, Fluid and biological sampling at IRINA II
273-CTD	NW of LHF-1	14°46,04'N 44°59,14'W	3250 m	25.05.05	Plume mapping and sampling
274-CTD	E of IRINA II	14°45,20'N 44°58,70'W	2731 m	25.05.05	Plume mapping and sampling
275-CTD	SE of LHF-1	14°44,41'N 44°57,21'W	2909 m	25.05.05	Plume mapping and sampling
276-CTD	SE of LHF-1	14°45,70'N 44°57,30'W	2912 m	25.05.05	Plume mapping and sampling
277-ROV	IRINA II	14°45,18'N 44°58,72'W	3046 m	25.05.05	Biological and fluid sampling
278-OFOS	NW of LHF-1	14°45,78'N 44°59,02'W	3200 m	26.05.05	SE-NW track, terminated early due to technical problems
279-CTD	NW of QUEST area	14°45,26'N 44°58,85'W	3044 m	26.05.05	Plume mapping and sampling
280-CTD	NW of LHF-1	14°47,01'N 45°00,00'W	3636 m	26.05.05	Plume mapping and sampling
281-ROV	QUEST	14°45,21'N 44°58,81'W	3053 m	26.05.05	Benthic chamber deployed at IRINA II, fluid, biological and geological sampling at QUEST site
282-HS	E of LHF-1	14°45,23'N		27.05.05	Bathymetry along W-E tracks

		44°58,83’W			
283-ROV	QUEST and IRINA II	14°45,22’N 44°58,81’W and 14°45,20’N 44°58,72’W	3047 m and 3033 m	27.05.05	Quest musselbed experiment, Fluid sampling at IRINA II T-measurements
284-OFOS	NW of LHF-1	14°45,23’N 44°58,83’W		28.05.05	Several tracks NW of LHF-1
285-ROV	QUEST and NW of LHF-1	14°45,22’N 44°58,79’W	3044 m	28.05.05	Final biological sampling at QUEST, exploration and mapping NW of LHF-1

Appendix 4:

ROV station & rock sampling protocols

The following abbreviations are used:

AM - Anke Meyerdierks
HS - Harald Strauß
JS - Jan Scholten
KL - Klas Lackschewitz
KS - Katja Schmidt
NA - Nico Augustin
SP - Sven Petersen
TK - Thomas Kuhn

Station Protocol M64/2

Station No.: 220 ROV (Dive 49) **Date (UTC):** 11.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives:

Station Begin

Time (UTC):	11:21	Lat (Ship):	14°45.27´N	Long (Ship):	44°58.83´W
		Depth (HS):	3051m		

Bottom Contact

Time (UTC):		Lat (Ship):		Long (Ship):	
		Depth (HS):		Cable out:	

Comments: 12:15 UTC > high power failure
> communication problem to the ROV
> ROV station cancelled at about 200m waterdepth

Off Bottom

Time (UTC):	-	Lat (Ship):	-	Long (Ship):	-
		Depth (HS):	-	Cable out:	-

Station End

Time (UTC):	12:58	Lat (Ship):	14°45.24	Long (Ship):	44°58.88
		Depth (HS):	3050m		

Summary: station cancelled shortly after ROV deployment

Print Form

Station Protocol M64/2

Station No.: 224 ROV (Dive 50A) **Date (UTC):** 12.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: Deployment of OBT, fluidsampling at IRINA II

Station Begin

Time (UTC): 11:28 Lat (Ship): 14°45.26´N Long (Ship): 44°58.83´W

Depth (HS): 3058m

Bottom Contact

Time (UTC): - Lat (Ship): - Long (Ship): -

Depth (HS): - Cable out: -

Comments: dive cancelled as Station 220 ROV
> same problems due to high power lost

Off Bottom

Time (UTC): - Lat (Ship): - Long (Ship): -

Depth (HS): - Cable out: -

Station End

Time (UTC): 11:30 Lat (Ship): 14°45.26´N Long (Ship): 44°58.83´W

Depth (HS): 3058m

Summary:

Print Form

Station Protocol M64/2

Station No.: 224 ROV (Dive 50B) **Date (UTC):** 12.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: Deployment of OBT, fluidsampling at IRINA II

Station Begin

Time (UTC): 17:15 Lat (Ship): 14°45.22´N Long (Ship): 44°58.87´W

Depth (HS): 3048m

Bottom Contact

Time (UTC): 19:00 Lat (Ship): 14°45.23´N Long (Ship): 44°58.83´W

Depth (HS): 3047m Cable out: -

Comments

Off Bottom

Time (UTC): 23:10 Lat (Ship): 14°45.21´N Long (Ship): 44°58.72´W

Depth (HS): 3037m Cable out: -

Station End

Time (UTC): 03:22 Lat (Ship): 14°45.38´N Long (Ship): 44°58.81´W

Depth (HS): 3020m

Summary

> new beacon and OBT placed on seafloor (3048m ship at 14°45.23N, 44°58.82W)
> beacon No14 placed at 3035m waterdepth (14°45.23´N, 44°58.80´W)
> fluidsampling system successfully tested

Print Form

Station Protocol M64/2

Station No.: 232 ROV **Date (UTC):** 14.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: mussel transplant experiment at IRINA II

Station Begin

Time (UTC): 08:23 Lat (Ship): 14°45.18´N Long (Ship): 44°58.75´W

Depth (HS): 3042m

Bottom Contact

Time (UTC): 13:30 Lat (Ship): 14°45.21´N Long (Ship): 44°58.72´W

Depth (HS): ROV 3049m Cable out: -

Comments

Off Bottom

Time (UTC): 22:01 Lat (Ship): 14°45.18´N Long (Ship): 44°58.72´W

Depth (HS): ROV 3037m Cable out: -

Station End

Time (UTC): 01:22 Lat (Ship): 14°45.19´N Long (Ship): 44°58.95´W

Depth (HS): 3022m

Summary

Print Form

Station Protocol M64/2

Station No.: 244 ROV (Dive 52) **Date (UTC):** 17.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: collecting mussels and place them off vent site

Station Begin

Time (UTC):	11:11	Lat (Ship):	14°45.14´N	Long (Ship):	44°58.69´W
		Depth (HS):	3009m		

Bottom Contact

Time (UTC):	13:24	Lat (Ship):	14°45.18´N	Long (Ship):	44°58.76´W
		Depth (HS):	3040m	Cable out:	-

Comments

Off Bottom

Time (UTC):	23:37	Lat (Ship):	14°45.18´N	Long (Ship):	44°58.70´W
		Depth (HS):	3025m	Cable out:	-

Station End

Time (UTC):	01:40	Lat (Ship):	14°45.12´N	Long (Ship):	44°58.73´W
		Depth (HS):	3026m		

Summary

> six nets with mussels were collected and placed near beacon 14

Print Form

Rocksampling Protocol M64/2

Date (UTC) 17.05.2005 **Station** 244 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
244 ROV-10 (talus from the musselfield of IRINA II)	14°45.176'N 44°58.755'W	-	altered sulfide breccia, sulfide grains look corroded, some atacamite	HS SP

Print Form

Station Protocol M64/2

Station No.: 249 ROV (Dive 53) **Date (UTC):** 13.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: see "Comments"

Station Begin

Time (UTC):	12:19	Lat (Ship):	14°45.16´N	Long (Ship):	44°59.06´N
		Depth (HS):	3050m		

Bottom Contact

Time (UTC):	14:15	Lat (Ship):	14°45.21´N	Long (Ship):	44°58.78´W
		Depth (HS):	3051m	Cable out:	-

Comments: Objectives:
T.-measurement at musselfield of IRINA II, fluid sampling at ANNA LOUISE and IRINA I

Off Bottom

Time (UTC):	22:58	Lat (Ship):	14°45.20´N	Long (Ship):	44°58.74´W
		Depth (HS):	3049m	Cable out:	-

Station End

Time (UTC):	00:57	Lat (Ship):	14°45.20´N	Long (Ship):	44°58.60´W
		Depth (HS):	2990m		

Summary: Fluids were sampled and temperatures were meassured at IRINA I and ANNA LOUISE

Print Form

Station Protocol M64/2

Station No.: 252 ROV (Dive 54) **Date (UTC):** 19.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: Site "A" mapping and sampling

Station Begin

Time (UTC):	11:15	Lat (Ship):	14°45.03´N	Long (Ship):	44°58.69´W
		Depth (HS):	3001m		

Bottom Contact

Time (UTC):	12:58	Lat (Ship):	14°45.07´N	Long (Ship):	44°58.71´W
		Depth (HS):	3016m	Cable out:	-

Comments

Off Bottom

Time (UTC):	21:34	Lat (Ship):	14°45.18´N	Long (Ship):	44°58.74´W
		Depth (HS):	3043m	Cable out:	-

Station End

Time (UTC):	23:30	Lat (Ship):	14°45.20´N	Long (Ship):	44°58.20´W
		Depth (HS):	3044m		

Summary: Found site "A" and took a rock sample

Print Form

Rocksampling Protocol M64/2

Date (UTC) 19.05.2005 **Station** 252 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
252 ROV-1 (A-I)	14°45.067'N 44°58.655'W	max. 15x30x5	sulfides, chimney-piece	AM: A1 HS: A2, E1, H1, G1, G2, E2, D1, F1 KL: A2 SP: A3 JS: A4
252 ROV-2 (1-4)	14°45.068'N 44°58.66'W	10x15x3	layered chalcopyrite - pyrite chimney-piece from IRINA I	HS:1 KL: 2 SP: 3 JS: 4
252 ROV-3	14°45.085'N 44°58.703'W	5x3	sulfide piece from IRINA I	
252 ROV-4	14°45.085'N 44°58.703'W	-	grey sediment sample from border of crater of IRINA I sampled with shovel	
252 ROV-5	14°45.085'N 44°58.703'W	-	sulfide piece from IRINA I	HS:5-1

Print Form

Station Protocol M64/2

Station No.: 257 ROV (Dive 55) **Date (UTC):** 20.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: T-Logger deployment at IRINA II, sampling bacterial mat

Station Begin

Time (UTC): 11:41 Lat (Ship): 14°45.15´N Long (Ship): 44°58.97´W

Depth (HS): 3035m

Bottom Contact

Time (UTC): 14:45 Lat (Ship): 14°45.17´N Long (Ship): 44°58.72´W

Depth (HS): 3042m Cable out: -

Comments

Off Bottom

Time (UTC): 21:40 Lat (Ship): 14°45.10´N Long (Ship): 44°58.70´W

Depth (HS): 3018m Cable out: -

Station End

Time (UTC): 23:42 Lat (Ship): 14°45.10´N Long (Ship): 44°58.70´W

Depth (HS): 3030m

Summary

Print Form

Rocksampling Protocol M64/2

Date (UTC) 20.05.2005 **Station** 257 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
257 ROV-13	14°45.114'N 44°58.7'W	6x10cm	breccia filled Fe-oxide-hydroxide crusts, glimmering sulfides within from Site "B"	KL, NA
257 ROV-14	14°45.123'N 44°58.705'W	4x4cm	sulfide piece, chalcopyrite and pyrite (?), small amounts of quartz from Site "B"	HS: 1 SP: 2

Print Form

Station Protocol M64/2

Station No.: 261 ROV (Dive 56) **Date (UTC):** 21.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: Fluidsampling at Barad-Dûr (Site "A") and IRINA II

Station Begin

Time (UTC):	11:29	Lat (Ship):	14°45.04´N	Long (Ship):	44°58.80´W
		Depth (HS):	3064m		

Bottom Contact

Time (UTC):	13:13	Lat (Ship):	14°45.09´N	Long (Ship):	44°58.69´W
		Depth (HS):	3005m	Cable out:	-

Comments

Off Bottom

Time (UTC):	20:01	Lat (Ship):	14°45.07´N	Long (Ship):	44°58.66´W
		Depth (HS):	2992m	Cable out:	-

Station End

Time (UTC):	21:53	Lat (Ship):	14°45.09´N	Long (Ship):	44°58.79´W
		Depth (HS):	3045m		

Summary

> Fluid samples taken from Barad-Dûr and IRINA II
> sampled chimney pieces from Barad-Dûr

Print Form

Rocksampling Protocol M64/2

Date (UTC) 21.05.2005 **Station** 261 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
261 ROV-3 (A, B)	14°45.037'N 44°58.683'W	10x15cm	piece of sulfide chimney "Barad-Dur" at site "A"	HS: B1 SP: B2 JS: B3
261 ROV-4	14°45.037'N 44°58.683'W	15x20cm	piece of chimney, layered chalcopyrite	
261 ROV-12	-	7x15cm	layered sulfide chimney samples - accidential sampled	HS: 11-1 SP: 11-2 JS: 11-3
261 ROV-13	-	mm-sized grains	some mm-sized atacamite pieces - accidential sampled	SP

Print Form

Station Protocol M64/2

Station No.: 263 ROV (Dive 57) **Date (UTC):** 22.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: see "Comments"

Station Begin

Time (UTC):	13:15	Lat (Ship):	14°45.10´N	Long (Ship):	44°58.70´W
		Depth (HS):	3025m		

Bottom Contact

Time (UTC):	15:31	Lat (Ship):	14°45.12´N	Long (Ship):	44°58.67´W
		Depth (HS):	3005m	Cable out:	-

Comments: ANYA'S GARDEN, QUEST site, positioning OBP near OBT, musselfield experiment at IRINA II

Off Bottom

Time (UTC):	22:47	Lat (Ship):	14°45.20´N	Long (Ship):	44°58.77´W
		Depth (HS):	3053m	Cable out:	-

Station End

Time (UTC):	00:49	Lat (Ship):	14°45.20´N	Long (Ship):	44°58.67´W
		Depth (HS):	3019m		

Summary:

Print Form

Station Protocol M64/2

Station No.: 266 ROV (Dive 58) **Date (UTC):** 23.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: see "Comments"

Station Begin

Time (UTC):	11:06	Lat (Ship):	14°45.06´N	Long (Ship):	44°58.75´W
		Depth (HS):	3038m		

Bottom Contact

Time (UTC):	12:58	Lat (Ship):	14°45.16´N	Long (Ship):	44°58.72´W
		Depth (HS):	3042m	Cable out:	-

Comments: Objectives:
profiler messurements within the musselbed at IRINA II, fluid sampling at site "B"

Off Bottom

Time (UTC):	23:03	Lat (Ship):	14°45.18´N	Long (Ship):	44°58.75´W
		Depth (HS):	3033m	Cable out:	-

Station End

Time (UTC):	01:14	Lat (Ship):	14°45.12´N	Long (Ship):	44°58.65´W
		Depth (HS):	2984m		

Summary: Highest temp. of 350°C were measured at site "B"

Print Form

Rocksampling Protocol M64/2

Date (UTC) 23.05.2005 **Station** 266 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
266 ROV-12	14°45.09´N 44°58.68´W	6x5x5	massive sulfide from site "B", main mineral is chalcopyrite, secondary Cu-sulfides, iron-oxide crust, atacamite on top of crust sample taken accidently by ROV	HS
266 ROV-13	14°45.09´N 44°58.68´W	Filter	fine dark-grey to black dust on glass-fibre filter, some individual larger chalcopyrite crystals	SP

Print Form

Station Protocol M64/2

Station No.: 272 ROV (Dive 59) **Date (UTC):** 24.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: positioning TS-mooring, fluid sampl. + videomosaic at IRINA II

Station Begin

Time (UTC): 14:26 Lat (Ship): 14°45.16´N Long (Ship): 44°58.75´W

Depth (HS): 3034m

Bottom Contact

Time (UTC): 16:13 Lat (Ship): 14°45.12´N Long (Ship): 44°58.63´W

Depth (HS): 2989m Cable out: -

Comments

Off Bottom

Time (UTC): 22:06 Lat (Ship): 14°45.25´N Long (Ship): 44°58.72´W

Depth (HS): 3051m Cable out: -

Station End

Time (UTC): 00:00 Lat (Ship): 14°45.21´N Long (Ship): 44°58.64´W

Depth (HS): 3028m

Summary

Print Form

Rocksampling Protocol M64/2

Date (UTC) 24.05.2005 **Station** 272 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
272 ROV-8	14°45.238'N 44°58.745'W	max. 5x10cm min. 2x2cm	Net with iron-oxide and -hydroxide crusts, some sulfide pebbles from inactive smoker near IRINA II	HS KS SP KL, NA

Print Form

Station Protocol M64/2

Station No.: 277 ROV (Dive 60) **Date (UTC):** 25.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: sampling at IRINA II

Station Begin

Time (UTC): 11:10 Lat (Ship): 14°45.19´N Long (Ship): 44°58.74´W

Depth (HS): 3049m

Bottom Contact

Time (UTC): 12:59 Lat (Ship): 14°45.19´N Long (Ship): 44°58.75´W

Depth (HS): 3047m Cable out: -

Comments

Off Bottom

Time (UTC): 21:55 Lat (Ship): 14°45.22´N Long (Ship): 44°58.77´W

Depth (HS): 3051m Cable out: -

Station End

Time (UTC): 23:53 Lat (Ship): 14°45.26´N Long (Ship): 44°58.54´W

Depth (HS): 2977m

Summary: Fluids and sulfides were sempled at IRINA II

Print Form

Rocksampling Protocol M64/2

Date (UTC) 25.05.2005 **Station** 277 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
277 ROV-2 (A-D)	14°45.176'N 44°58.749'W	ca. 5x10cm	sulfide chimney pieces from IRINA II	HS: D1 SP: D2 JS: D3
277 ROV-7 (A-G)	14°45.177'N 44°58.75'W	max. 15x20cm	sulfide chimney pieces from IRINA II	HS: A1, B1, C1 TK: A4, B4 SP: A2, B2, C2 JS: A3, B3, C3

Print Form

Station Protocol M64/2

Station No.: 281 ROV (Dive 61) **Date (UTC):** 26.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: bentic chamber exp., fluid + pushcore sampl. at QUEST site

Station Begin

Time (UTC): 11:42 Lat (Ship): 14°45.18´N Long (Ship): 44°58.99´W

Depth (HS): 3033m

Bottom Contact

Time (UTC): 13:36 Lat (Ship): 14°45.18´N Long (Ship): 44°58.72´W

Depth (HS): 3036m Cable out: -

Comments

Off Bottom

Time (UTC): 22:00 Lat (Ship): 14°45.20´N Long (Ship): 44°58.75´W

Depth (HS): 3046m Cable out: -

Station End

Time (UTC): 0:00 Lat (Ship): 14°45.20´N Long (Ship): 44°58.80´W

Depth (HS): 3042m

Summary

Print Form

Rocksampling Protocol M64/2

Date (UTC) 26.05.2005 **Station** 281 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
281 ROV-7	14°45.217'N 44°58.815'W	10x15x25cm	massive piece of active sulfide chimney from IRINA II	HS: A SP: B

Print Form

Station Protocol M64/2

Station No.: 283 ROV (Dive 62) **Date (UTC):** 27.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: new positioning of OBT, continue musselbed experiment

Station Begin

Time (UTC): 13:07 Lat (Ship): 14°45.20´N Long (Ship): 44°58.88´W

Depth (HS): 3027m

Bottom Contact

Time (UTC): 15:09 Lat (Ship): 14°45.23´N Long (Ship): 44°58.74´W

Depth (HS): 3043m Cable out: -

Comments

Off Bottom

Time (UTC): 22:21 Lat (Ship): 14°45.20´N Long (Ship): 44°58.73´W

Depth (HS): 3033m Cable out: -

Station End

Time (UTC): 0:12 Lat (Ship): 14°45.21´N Long (Ship): 44°58.71´W

Depth (HS): 3027m

Summary

Print Form

Station Protocol M64/2

Station No.: 285 ROV (Dive 63) **Date (UTC):** 28.05.2005

☒ ***ROV*** ☐ ***OFOS*** ☐ ***GTV*** ☐ ***CTD*** ☐ ***MAPR***

Objectives: mapping the area NW of QUEST site

Station Begin

Time (UTC): 12:11 Lat (Ship): 14°45.23´N Long (Ship): 44°58.97´W

Depth (HS): 3025m

Bottom Contact

Time (UTC): 14:09 Lat (Ship): 14°45.22´N Long (Ship): 44°58.82´W

Depth (HS): 3046m Cable out: -

Comments: discovered new diffuse vent site

Off Bottom

Time (UTC): 21:52 Lat (Ship): 14°45.36´N Long (Ship): 44°58.87´W

Depth (HS): 3061m Cable out: -

Station End

Time (UTC): 23:37 Lat (Ship): 14°45.37´N Long (Ship): 44°58.87´W

Depth (HS): 3064m

Summary: discovered and sampled a new diffuse venting site NW of QUEST site

Print Form

Rocksampling Protocol M64/2

Date (UTC) 28.05.2005

Station 285 ROV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
285 ROV-6	14°45.31'N 44°58.875'W	max. ca. 5cm pieces	Fe-oxide, -hydroxide crusts and mud from new diffuse venting-site NW of QUEST	HS KS KL, NA

Print Form

Appendix 5:

GTV station & rock sampling protocols

The following abbreviations are used:

AM - Anke Meyerdierks
HS - Harald Strauß
JS - Jan Scholten
KL - Klas Lackschewitz
KS - Katja Schmidt
NA - Nico Augustin
SP - Sven Petersen
TK - Thomas Kuhn

Station Protocol M64/2

Station No.: 222 GTV **Date (UTC):** 11.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling hydrothermal precipitates seen in 2004 (M60/3)

Station Begin

Time (UTC): 17:32 Lat (Ship): 14°44.96´N Long (Ship): 44°58.95´W

Depth (HS): 3067m

Bottom Contact

Time (UTC): 18:43 Lat (Ship): 14°45.00´N Long (Ship): 44°58.94´W

Depth (HS): 3056m Cable out: 3117m

Comments
- VHS record started at 18:35 UTC (Time on VHS is 01:51, 01.01.01)
- Bottom-sight at VHS at 01:59, VHS stopped at 19:09 UTC (VHS 02:24)

- grap at Lat. 14°44.99´N, Long. 44°58.97´W, depth 3069m, cable 3142m

Off Bottom

Time (UTC): 19:10 Lat (Ship): 14°44.99´N Long (Ship): 44°58.97´W

Depth (HS): 3069m Cable out: 3132m

Station End

Time (UTC): 20:15 Lat (Ship): 14°44.96´N Long (Ship): 44°58.95´W

Depth (HS): 3072m

Summary
> serpentinized peridotites and pyroxenites, partly Mn-coated,
> some atacamite
> some sediment samples taken by biologists

Print Form

Rocksampling Protocol M64/2

Date (UTC) 11.05.2005 **Station** 222 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
222 GTV-1 (A-G)	14°44,99´N 44°58,97´W	1-2 dm	serpentinized, coarse grained (up to 3cm) pyroxenites, silica altered graines with a dark green to black mm-sized rim, some <1cm in diameter quartz geodes, partly Mn-stained (<1mm)	KL, NA (A-F) HS (G)
222 GTV-2 (A-D)	14°44,99´N 44°58,97´W	1-1,5 dm	massive serpentinized peridotites, fine grained (mm-sizes), thin Mn- and Fe-oxide coating (<1mm)	KL, NA (A-D)
222 GTV-3 (A-D)	14°44,99´N 44°58,97´W	1-2 dm	strongly weathered, serpentinized pyroxenites, fine to coarse grained, thin (<1mm) Mn-coating and Fe-oxide impregnation	Kl, NA (A-C) KS (D)
222 GTV-4 (A-L)	14°44,99´N 44°58,97´W	1-2 dm	full Mn-coated, serpentinized peridotites, grain size up to 5mm, traces of orange Fe-oxides	KS (A-D) JS (E-F) TK (G-J) Archive (K-N)
222 GTV-5	14°44,99´N 44°58,97´W	some mm up to 1dm	Fe-oxide crust (mm-thick) with thin (<1mm) Mn-coating and atacamite within	SP
			KL - Klas Lackschewitz NA - Nico Augustin HS - Harald Strauß KS - Katja Schmidt JS - Jan Scholten TK - Thomas Kuhn SP - Sven Petersen	

Print Form

Station Protokoll M64/2

Station No.: 225 GTV **Date (UTC):** 12.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling hydrotherm. sediments and crusts 100m SW IRINA II

Station Begin

Time (UTC): 13:25 Lat (Ship): 14°45.13´N Long (Ship): 44°58.81´W

Depth (HS): 3050m

Bottom Contact

Time (UTC): 14:31 Lat (Ship): 14°45.12´N Long (Ship): 44°58.80´W

Depth (HS): 3047m Cable out: 3048m

Comments
VHS Start: 21:40:13 / 14:26 UTC
VHS Stop: 21:57:45 / 14:43 UTC

Grab: 14°45.19´N, 44°58.82´W, 14:37 UTC, Depth 3049m,Cable 3110m

Off Bottom

Time (UTC): 14:42 Lat (Ship): 14°45.21´N Long (Ship): 44°58.80´W

Depth (HS): 3046m Cable out: 2082m

Station End

Time (UTC): 15:50 Lat (Ship): 14°45.21´N Long (Ship): 44°58.84´W

Depth (HS): 3043m

Summary
no hydrothermal sediments or crusts found, no sulfides
> weakly serpentinized pyroxenites, some Mn-crusts

Print Form

Rocksampling Protocol M64/2

Date (UTC) 12.05.2005 **Station** 225 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
225 GTV-1 (A-F)	14°45.19´N 44°58.82´W	5cm - 2dm (subsample F about 5x2dm)	fine to coarse grained, weakly serpentinized pyroxenites, Mn coated (<1mm up to 1.5cm), some partly Fe-oxide impregnated, dark green to black fissures	
225 GTV-2	14°45.19´N 44°58.82´W	1dm	type like #1 but in great parts silica (Qtz?) cemented, no Fe-oxides	
225 GTV-3 (A-E)	14°45.19´N 44°58.82´W	up to 5cm in diameter	Mn-crusts and small pieces like #1 with Mn-crust	
225 GTV-4	14°45.19´N 44°58.82´W	-	pelagic sediment (bright brown foraminifere-grouse)	

Print Form

Station Protocol M64/2

Station No.: 229 GTV **Date (UTC):** 13.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling about 50m W of IRINA I

Station Begin

Time (UTC): 00:05 Lat (Ship): 14°45.07´N Long (Ship): 44°58.75´W

Depth (HS): 3039m

Bottom Contact

Time (UTC): 01:10 Lat (Ship): 14°45.01´N Long (Ship): 44°58.70´W

Depth (HS): 3032m Cable out: 3031m

Comments
VHS Start: 08:20:30 / 01:06 UTC
VHS Stop: 08:34:30 / 01:20 UTC

Grap: 14°45.08´N, 44°58.72´W, 01:17 UTC, HS 3023m, cable out 3040m

Off Bottom

Time (UTC): 01:20 Lat (Ship): 14°45.08´N Long (Ship): 44°58.72´W

Depth (HS): 3024m Cable out: 3030m

Station End

Time (UTC): 02:29 Lat (Ship): 14°44.94´N Long (Ship): 44°58.73´W

Depth (HS): 3077m

Summary
silified crusts, Mn-coated, sulfide-sediment, pyroxene mud

> GAPS was tryed but not working

Print Form

Rocksampling Protocol M64/2

Date (UTC) 13.05.2005 **Station** 229 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
229 GTV-1 (A-D)	14°45.08´N 44°58.70´W	40 x 5	silified lamellar crusts with sediment included between lamells, thin (<1mm) Mn, coating on top of samples	
229 GTV-2 (A-C)	14°45.08´N 44°58.70´W	15 x 3	fragile lamellare silified crust like #1 but with small cavities (5 x 10 mm), thin Mn-coating, sample B wih thicker Mn-coating (~ 0.5 to 10mm)	KS: A TK: B JS: C
229 GTV-3	14°45.08´N 44°58.70´W	20 x 5	solidified mud, light-brown, Fe-oxides and glimmering sulfides (pyrite / marcasite ?)	
229 GTV-4 (A-C)	14°45.08´N 44°58.70´W	-	grey to dark-grey sulfide mud, small glimmering pyrite / marcasite (?) grains	KL, NA: A SP: B HS: C
229 GTV-5	14°45.08´N 44°58.70´W	-	grey to dark-grey sulfide mud like #4 but with pyroxene gravel (<10mm)	KL, NA
229 GTV-6	14°45.08´N 44°58.70´W	-	black sulfide-mud including basaltic glass chips, markasite (?) and gypsum (?)	HS, SP

Print Form

Station Protocol M64/2

Station No.: 230 GTV **Date (UTC):** 14.04.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling 50m SW of site A

Station Begin

Time (UTC): 03:40 Lat (Ship): 14°44.99´N Long (Ship): 44°58.64´W

Depth (HS): 2967m

Bottom Contact

Time (UTC): 04:50 Lat (Ship): 14°44.97´N Long (Ship): 44°58.61´W

Depth (HS): 2948m Cable out: 2987m

Comments
VHS Start: 12:00:36 / 04:46 UTC
VHS Stop: 12:30:00 / 05:15 UTC

Grap: 14°45.01´N, 48°58.68´N, 05:12 UTC, HS 3000m, cable out 3037m

Off Bottom

Time (UTC): 05:15 Lat (Ship): 14°45.00´N Long (Ship): 44°58.68´W

Depth (HS): 3000m Cable out: -

Station End

Time (UTC): 06:18 Lat (Ship): 14°44.95´N Long (Ship): 44°58.52´W

Depth (HS): 2872m

Summary
Mn-coated, weathered pyroxenites
and some biology

Print Form

Rocksampling Protocol M64/2

Date (UTC) 14.05.2005 **Station** 230 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
1 (A-H)	14°45.01´N 44°58.68´W	dm-sized	Mn-coated (max. 1cm) pyroxenites, grainsize up to 5cm in lengh, colour of pyroxenes vary from light-brown to black-green, pyroxenites are weathered and brittle, some Qtz (?) inclusions	KL, NA: A, B, C, E2 TK: E1, D1, G JS: D2, H KS: D3, F

Print Form

Station Protocol M64/2

Station No.: 239 GTV **Date (UTC):** 15.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling 400m E of IRINA II

Station Begin

Time (UTC): 16:47 Lat (Ship): 14°45.22´N Long (Ship): 44°58.53´W

Depth (HS): 2970m

Bottom Contact

Time (UTC): 17:50 Lat (Ship): 14°45.23´N Long (Ship): 44°58.53´W

Depth (HS): 2968m Cable out: 3011m

Comments
VHS Start: 01:00:35 / 17:46 UTC
VHS Stop: 01:29:15 / 18:15 UTC

Grab: 14°45.23´N, 44°58.58´W, 18:11 UTC, HS 2988m, cable 3075m

Off Bottom

Time (UTC): 18:14 Lat (Ship): 14°45.22´N Long (Ship): 44°58.57´W

Depth (HS): 2986m Cable out: 3014m

Station End

Time (UTC): 19:20 Lat (Ship): 14°45.15´N Long (Ship): 44°58.41´W

Depth (HS): 2876m

Summary
light brown clay with mussel- and snail-shells on top and between, in the middle grouse of Mn-crusts, atacamite grouse and talc, hematite-impregnated serpentinites, two bigger (~20cm in diameter) atacamite-crusts

Print Form

Rocksampling Protocol M64/2

Date (UTC) 15.05.2005 **Station** 239 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
239 GTV-1 (A-D)	14°45.23´N, 44°58.58´W	1-10	atacamite and atacamite crusts, very briddle, some inclusions of talc (altered serpentinite) and brown clay, atacamite mostly colomorph but some dark-green crystals (<0.5mm) are viewable, thin Mn-coating (<0.5mm) in some range	SP: A3, B, C KL, NA: A1, A2
239 GTV-2	14°45.23´N, 44°58.58´W	5x20	honeycomb structured, silicified crusts with atacamite and Mn-minerals within, some hematite-impregnated zones	KL, NA
239 GTV-3	14°45.23´N, 44°58.58´W	max. 3cm in diameter	solidified sediment-clusters with red color from hematite, some spots with atacamite, thin Mn-coating (<0.5mm)	KL, NA
239 GTV-4	14°45.23´N, 44°58.58´W	max. 5cm in diameter	massive talc-altered serpentinites, soft, mostly light-brown through clay cover, sometimes fibrillar grains (from chrysotile ?), some atacamite-grains within	KL, NA
239 GTV-5	14°45.23´N, 44°58.58´W	-	max. 1.5cm thick Mn-crusts, partly with some atacamite	
239 GTV-6	14°45.23´N, 44°58.58´W	-	red-brown sediment (hematite rich ?)	
239 GTV-7	14°45.23´N, 44°58.58´W	-	light-brown sediment / clay	

Print Form

Station Protocol M64/2

Station No.: 250 GTV **Date (UTC):** 19.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sampling future drilling site, WNW of site "B"

Station Begin

Time (UTC): 01:07 Lat (Ship): 14°45.11´N Long (Ship): 44°58.69´W

Depth (HS): 3014m

Bottom Contact

Time (UTC): 02:10 Lat (Ship): 14°45.14´N Long (Ship): 44°58.71´W

Depth (HS): 3027m Cable out: 3049m

Comments
VHS on: 09:21:15
VHS off: 09:54:40

Grab: 14°45.16´N, 44°58.77´W

Off Bottom

Time (UTC): 02:37 Lat (Ship): 14°45.17´N Long (Ship): 44°58.77´W

Depth (HS): 3050m Cable out: 3091m

Station End

Time (UTC): 03:46 Lat (Ship): 14°45.16´N Long (Ship): 44°58.78´W

Depth (HS): 3049m

Summary
> green serpentine-grouse layer in sediment with a temp. of 43°C

Print Form

Rocksampling Protocol M64/2

Date (UTC) 19.05.2005 **Station** 250 GTV (1/2)

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
250 GTV -1 (A, B)	14°45.16´N, 44°58.77´W	max. 10x20	completely altered peridotite, green serpentine grains in black matrix, magnetite grains (<0.5mm) in matrix and serpentine, some withe talc (?)	KL, NA
250 GTV -2	14°45.16´N, 44°58.77´W	40x25	nearly complete altered pyroxenite, some former pyroxenes seeable, small (<1mm) honeycomb structures, orange-brown clay minerals in matrix	KL, NA
250 GTV -3 (A, B)	14°45.16´N, 44°58.77´W	20x20	altered, coarse grained pyroxenites, some more or less preserved pyroxene grains, orange-brown colored from clay minerals	KL, NA
250 GTV -4	14°45.16´N, 44°58.77´W	10x10	light green, groused serpentinized peridotite, grain size max 5mm, talc and serpentine are main components	KL, NA
250 GTV -5	14°45.16´N, 44°58.77´W	max. 5x7	massive quartz-veins	
250 GTV -6	14°45.16´N, 44°58.77´W		Mn-coated, Fe-oxide-hydroxide crusts	

Print Form

Rocksampling Protocol M64/2

Date (UTC) 19.05.2005 **Station** 250 GTV (1/2)

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
250 GTV-7	14°45.16´N, 44°58.77´W	-	serpentite-grouse, coarse grained, in-situ temperature was about 43°C	KL, NA
250 GTV-8	14°45.16´N, 44°58.77´W	-	orange-brown sediment	KL, NA

Print Form

Station Protocol M64/2

Station No.: 258 GTV **Date (UTC):** 20.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: sulfidesampling near M60-3 83GTV, NW of Irina II

Station Begin

Time (UTC): 23:52 Lat (Ship): 14°45.22´N Long (Ship): 44°58.75´W

Depth (HS): 3044m

Bottom Contact

Time (UTC): 00:59 Lat (Ship): 14°45.26´N Long (Ship): 44°58.75´W

Depth (HS): 3049m Cable out: 3088m

Comments VHS on: 08:04:35 (00:50 UTC)
1:22 UTC OBT and Beacon 14 in sight (VHS 08:38 tape-time)

Grab: 14°45.21´N, 44°58.76´W, 1:36 UTC, HS: 3049m

Off Bottom

Time (UTC): 01:38 Lat (Ship): 14°45.21´N Long (Ship): 44°58.76´W

Depth (HS): 3052m Cable out: 3075m

Station End

Time (UTC): 02:48 Lat (Ship): 14°46.50´N Long (Ship): 44°58.82´W

Depth (HS): 3060m

Summary recovered old Calyptogena shills, old clam-field
no sulfides, some Mn-coated serpentinites

Print Form

Rocksampling Protocol M64/2

Date (UTC) 21.05.2005 **Station** 258 GTV

Sample-Number	Lat / Long	Size (cm)	Description	Sample taken by
258 GTV-1	14°45.21´N, 44°58.76´W	max. 3x4	Mn-coated, coarse-grained serpentinized peridotites	
258 GTV-2	14°45.21´N, 44°58.76´W	-	some mud and grouse from GTV	

Print Form

Station Protocol M64/2

Station No.: 259 GTV **Date (UTC):** 21.05.2005

☐ *ROV* ☐ *OFOS* ☒ *GTV* ☐ *CTD* ☐ *MAPR*

Objectives: biological sampling at "QUEST"-site

Station Begin

Time (UTC): 04:05 Lat (Ship): 14°45.21´N Long (Ship): 44°58.84´W

Depth (HS): 2758m

Bottom Contact

Time (UTC): 05:19 Lat (Ship): 14°45.23´N Long (Ship): 44°58.84´W

Depth (HS): 3040m Cable out: 3069m

Comments VHS on: 12:25:30 (05:15 UTC)
VHS off: 14:04

grab: 14°45.24´N, 44°58.84´W

Off Bottom

Time (UTC): 06:45 Lat (Ship): 14°45.28´N Long (Ship): 44°58.90´W

Depth (HS): 3035m Cable out: -

Station End

Time (UTC): 07:45 Lat (Ship): 14°45.13´N Long (Ship): 44°58.79´W

Depth (HS): 3035m

Summary no samples were recovered, grab was open, station was canceled

OBP-discovered at 14°45.233´N, 44°58.827´W

Print Form

Appendix 6:

List of hydrothermal fluid subsamples taken for further analyses on-shore

St. No M 64/2	Instrument	Dive type	Location	CH_4, H^2, ∂D	$\partial^{34}S$ SO_4	$\partial^{34}S$ S^{2-}	$\partial^{13}C$, $\partial^{18}O$	DIC	$\partial^{15}N$ Amino acids	Alka-linity	$\partial^{44}Ca$	Total Trace metals	Diss. Trace metals I	Diss. REE, PGE	Diss. Major ions	An-ions	Diss. Trace metals II	$\partial^{178}Hf$	Metal organic
Lab				U-HH	U-MS	U-MS	U-MS	U-MS	U-MS	GEOM	GEOM	U-KI	U-KI	U-KI	U-KI	IUB	IUB	IUB	U-OTAG
224 ROV- 4	KIPS	Test	Irina-2 Smoker	X	X	X	X	X	-	X	X	-	X	-	X	X	X		
232 ROV-3	KIPS	Bio	Irina-2 Mussel bed	X	X	X	X	X	-	X	X	-	X	-	X	X	X		
232 ROV-7	KIPS	Bio	Irina-2 Mussel bed	X	X	X	X	X	-	X	X	-	X	-	X	X	X		
249 ROV-7	KIPS	Geo	Anna Louise Smoker	X	-	X	X	X	-	X	X	X	X	X	X	X	X		
249 ROV-9	KIPS	Geo	Irina Smoker	X	-	X	X	X	-	X	X	X	X	-	X	X	X		
257 ROV-8	KIPS	Geo	Site „B“ Smoker	X	X	X	X	X	X	X	X	X	X	-	X	X	X		
261 ROV-6	ROV	Geo	Irina Smoker	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
266 ROV-6	ROV	Bio	Irina II musselbed	X	X	-	X	X	X	X	X	-	X	-	X	X	X		
266 ROV-10	ROV	Geo	Site „B“ Smoker	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

St. No M 64/2	Instrument	Dive type	Location	CH_4, H^2, ∂D	$\partial^{34}S$ SO_4	$\partial^{34}S$ S^{2-}	$\partial^{13}C$, $\partial^{18}O$	DIC	$\partial^{15}N$ Amino acids	Alka-linity	$\partial^{44}Ca$	Total Trace metals	Diss. Trace metals I	Diss. REE, PGE	Diss. Major ions	An-ions	Trace metals II	$\partial^{178}Hf$	Metal organic
Lab				U-HH	U-MS	U-MS	U-MS	U-MS	U-MS	GEOM	GEOM	U-KI	U-KI	U-KI	U-KI	IUB	IUB	GEOM	U-OTAG
277 ROV-5	KIPS	Geo	Irina II Smoker	X	X	X	X	X	X	X	X	X	X	-	X	X	X		
281 ROV-2	KIPS	Bio	Quest Mussel bed	X	X	X	X	X	X	X	X	-	X	-	X	X	X		
281 ROV-5	KIPS	Geo	Quest Smoker	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
283 ROV-4	KIPS	Geo	Irina II Smoker	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

U-HH = University of Hamburg, U-MS = University of Münster, GEOM = IFM Geomar-Kiel, U-KI = University of Kiel, IUB = International University Bremen, U-OTAG = University of Otago, New Zealand

Appendix 7:

List of microbiological samples

by Miriam Perner and Andrea Gärtner

(B= Bottle from fluid sampling system N=Niskin bottle; F= Filter fluid sampling system).

Station	Fluid/ Sediment	Clone library	FISH	DSMO/ Glycerin	Enrichments
217 CTD	watercolumn	12 Water depths	12 Water depths	----------	----------
219 CTD	watercolumn	12 Water depths	12 Water depths	----------	----------
221 CTD	watercolumn	12 Water depths	12 Water depths	----------	----------
222 GTV	222 GTV 6 sediment	222 GTV 6	----------	----------	----------
	222 GTV 7 Serpentinit (rock)	222 GTV 7	----------	----------	----------
224 ROV	224 Rov 4a (Subsample of hydrothermal fluid)	224Rov 4a1 (filter)	224 Rov 4a2 (filter)	224 Rov 4a3	6 Enrichments 224 Rov 4a4 224 Rov 4a5 224 Rov 4a6 224 Rov 4a7 224 Rov 4a8 224 Rov 4a9
225 GTV	225 GTV 5 (Sediment)	225 GTV 5	----------	----------	----------
227 CTD	Watercolumn	10 Water depths	10 Water depths	----------	----------
229 GTV	229 GTV A grey Sediment (Pyrit)	229 GTV A1	229 GTV A2	----------	5 enrichments 229 GTV A3 229 GTV A4 229 GTV A5 229 GTV A6 229 GTV A7
	229 GTV B brown sediment	229 GTV B1	229 GTV B1	----------	----------
	229 GTV C manganese crust	229 GTV C1	229 GTV C2	----------	----------
	229 GTV D brown sediment	229 GTV D1	229 GTV D2	----------	----------
	229 GTV E layered crust	229 GTV E1	229 GTV E2	----------	----------
230 GTV	230 GTV 2 (brown sediment)	230 GTV 2	----------	----------	----------
231 CTD	Watercolumn	11 Water depths	11 Water depths	--------	----------
232 ROV	232 Rov 5a Byssus scraped of off mussles	232 Rov 5a1	232 Rov 5a2	232 Rov 5a3	4 enrichments 232 Rov 5a4 232 Rov 5a5 232 Rov 5a6 232 Rov 5a7
	232 Rov 7a (Subsample of hydrothermal fluid)	232 Rov 7a1 (filter)	232 Rov 7a2 (filter)	----------	4 enrichments 232 Rov 7a3 232 Rov 7a4 232 Rov 7a5 232 Rov 7a6
	232 Rov 8	232 Rov 8.1 (filter)	232 Rov 8.2 (filter)	----------	----------

239 GTV	239 GTV A **(**black mud)	----------	----------	----------	4 enrichments 239 GTV A1 239 GTV A2 239 GTV A3 239 GTV A4
	239 GTV D (sticky mud)	----------	----------	----------	4 enrichments 239 GTV D1 239 GTV D2 239 GTV D3 239 GTV D4
	239 GTV E (surface of mussels)	----------	----------	----------	2 enrichments 239 GTV E1 239 GTV E2
248 CTD	Watercolumn	11 Water depths	11 Water depths	----------	----------
249 ROV	249ROV 7a (Subsample of hydrothermal fluid)	249 Rov 7a1 (filters)	249 Rov 7a2 (filters)	249 Rov 7a3	4 enrichments 249 Rov 7a4 249 Rov 7a5 249 Rov 7a6 249 Rov 7a7
	249ROV 9a (Subsample of hydrothermal fluid)	249ROV 9a1 (filter)	249ROV 9a2 (filter)	249ROV 9a3	4 enrichments 249ROV 9a4 249ROV 9a5 249ROV 9a6 249ROV 9a7
250 GTV	250 GTV 7 (brownish sediment)	250 GTV 7.1	250 GTV 7.2	----------	----------
	250 GTV 8 (dark sediment)	250 GTV 8.1	250 GTV 8.2	----------	----------
	250 GTV 9 (brownish sediment)	250 GTV 9.1	250 GTV 9.2	----------	----------
	250 GTV 10 **(**brown sediment)	250 GTV 10.1	250 GTV 10.2	----------	----------
252 ROV	252 ROV 4a (subsample from sediment sample)	252 ROV 4a1	252 ROV 4a2	----------	2 enrichments 252 ROV 4a3 252 ROV 4a4
254 CTD	Watercolumn	9 Water depths	9 Water depths	----------	----------
255 CTD	Watercolumn	3 Water depths	3 Water depths	----------	----------
257 ROV	257 Rov 6a (subsample from microbial mat)	257 Rov 6a1	257 Rov 6a2	----------	5 enrichments 257 Rov 6a3 257 Rov 6a4 257 Rov 6a5 257 Rov 6a6 257 Rov 6a7

	257Rov 8a (subsample from hydrothermal fluid)	----------	----------	----------	6 enrichments 257Rov 8a1 257Rov 8a2 257Rov 8a3 257Rov 8a4 257Rov 8a5 257Rov 8a6 5 enrichments for temperature gradient experiment 257Rov 8a7 257Rov 8a8 257Rov 8a9 257Rov 8a10 257Rov 8a11
	257 ROV 9	257 ROV 9.1 (filter)	257 ROV 9.2 (filter)	----------	----------
261 ROV	261 Rov 1a (subsample from hydrothermal fluid)	----------	----------	261 Rov 1a1	5 enrichments 261 Rov 1a2 261 Rov 1a3 261 Rov 1a4 261 Rov 1a5 261 Rov 1a6
	261 Rov 6a (subsample from hydrothermal fluid)	----------	----------	261 Rov 6a1	6 enrichments 261 Rov 6a2 261 Rov 6a3 261 Rov 6a4 261 Rov 6a5 261 Rov 6a6 261 Rov 6a7 5 enrichments for temperature gradient experiment 261 Rov 6a8 261 Rov 6a9 261 Rov 6a10 261 Rov 6a11 261 Rov 6a12
	261 Rov 7	261 Rov 7.1 (filter)	261 Rov 7.2 (filter)	----------	----------
263 ROV	263 Rov 3a (subsample from Niskin #4)	263 Rov 3a1 (filter)	263 Rov 3a2 (filter)	----------	----------
	263 Rov 6a (Byssus from t-logger #3)	263 Rov 6a1	263 Rov 6a2	263 Rov 6a3	----------
266 ROV	266 Rov 10a (subsample of hydrothermal fluid)	266 Rov 10a1 (filter)	266 Rov 10a2 (filter)	266 Rov 10a3	3 enrichments 266 Rov 10a4 266 Rov 10a5 266 Rov 10a6
272 ROV	272 Rov 3a (subsample from Niskin #2)	272 Rov 3a1 (filter)	272 Rov 3a2 (filter)	----------	----------

277 ROV	277 Rov 2a (surface structure of stone)	277 Rov 2a1	-------	----------	----------
	277 Rov 2b (surface structure of stone)	277 Rov 2b1	277 Rov 2b2	----------	----------
	277 Rov 2c (surface structure of stone)	277 Rov 2c1	277 Rov 2c2	----------	3 enrichments 277 Rov 2c3 277 Rov 2c4 277 Rov 2c5
	277 Rov 2d (surface structure of stone)	277 Rov 2d1	277 Rov 2d2	----------	----------
	277 Rov 3a (subsample of hydrothermal fluid)	277 Rov 3a1 (filter)	277 Rov 3a2 (filter)	----------	----------
	277 Rov 4a (subsample of hydrothermal fluid)	----------	----------	277 Rov 4a1	5 Enrichments for the temperature gradient experiment 277 Rov 4a2 277 Rov 4a3 277 Rov 4a4 277 Rov 4a5 277 Rov 4a6
279 CTD	Watercolumn	10 Water depths	10 Water depths	----------	----------
281 ROV 283 Rov	281 Rov 5a (subsample hydrothermal fluid)	----------	----------	281 Rov 5a1	10 enrichments 281 Rov 5a2 281 Rov 5a3 281 Rov 5a4 281 Rov 5a5 281 Rov 5a6 281 Rov 5a7 281 Rov 5a8 281 Rov 5a9 281 Rov 5a10 281 Rov 5a11
	281 Rov 6 (hydrothermal fluid)	281 Rov 6.1 (filter)	281 Rov 6.2 (filter)	----------	----------
	281 Rov 11 (pushcore experiment – pushcore #2)	281 Rov 11.1	----	281 Rov 11.2	5 enrichments 281 Rov 11.3 281 Rov 11.4 281 Rov 11.5 281 Rov 11.6 281 Rov 11.7
	281 Rov 12 (pushcore experiment – pushcore # 1	281 Rov 12.1	----	281 Rov 12.2	5 enrichments 281 Rov 12.3 281 Rov 12.4 281 Rov 12.5 281 Rov 12.6 281 Rov 12.7

	283 Rov 4a (subsample hydrothermal fluid)	------	------	------	8 enrichments 283 Rov 4a1 283 Rov 4a2 283 Rov 4a3 283 Rov 4a4 283 Rov 4a5 283 Rov 4a6 283 Rov 4a7 283 Rov 4a8
285 ROV	283 Rov 5 (hydrothermal fluid)	283 Rov 5.1 (filter)	283 Rov 5.2 (filter)	-----	------
	285 Rov 2a (subsample from Niskin #4)	285 Rov 2a1	285 Rov 2a2	----	-----

Appendix 8:

Station list of zoological samples

by Jens Stecher

Date	Station No.	Site / Location
11.05.2005	222GTV-A	approx. .450m SW of “IRINA II”
12.05.2005	225 GTV-A	approx.100m SW of “IRINA II”
13.05.2005	229 GTV-A	50m S of “IRINA I”, 25m W of “ANNA LOUISE”
14.05.2005	230 GTV-A	100m S of “ANNA LOUISE2, 150m SW of site “A”
14.05.2005	232ROV#5	IRINA II, 3m S of smoker-complex, mussel-site 1
15.05.2005	239GTV-A	400m E of “IRINA II”, EH-anomaly measured during M60/3
18.05.2005	249 ROV#5	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
18.05.2005	244ROV#7 (Net No 4)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
19.05.2005	250GTV	25m S of “IRINA II", possible target for the drilling programme in 2006
19.05.2005	252 ROV#1	Site "A" at the black smoker "Barad-Dur"
19.05.2005	252ROV#6, (Net No 9)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
19.05.2005	244ROV#6, (Net No 6)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
20.05.2005	257 ROV#10	Site "B", Black Smoker (Marker "MA")
20.05.2005	257 ROV#12	Site "B", Black Smoker (Marker "MA")
20.05.2005	258GTV	20m N of “IRINA II”, nearby 83 GTV of cruise M60/3
21.05.2005	261ROV#3	Site "A" at the Black Smoker "Barad-Dur"
21.05.2005	261ROV#5	“IRINA I”, semicircular *Bathymodiolus*-patch, 3m NW of sampled Smoker, nearby marker "MD", former beacon 11
22.05.2005	244ROV#8, (Net No 2)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
22.05.2005	244ROV#5, (Net No 5)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
22.05.2005	263ROV#4	Slope W of “IRINA II”, nearby the marker "Anya"
22.05.2005	263ROV#6	Mussel-patch at "QUEST" site
23.05.2005	266 ROV#7	“IRINA II”, 3m S of the smoker-complex, nearby T-logger No4 of M60/3, mussel-site 1
23.05.2005	266 ROV#11	Site "B", black smoker nearby marker "MA"
24.05.2005	244ROV#9, (Net No 8)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
24.05.2005	268CTD	44°58.0´W; 14°44.0´N, 2972m
24.05.2005	272ROV#6	“IRINA II”, E- wall of the smoker-complex, placed in the "Shrimps Gap"
25.05.2005	277ROV#6	“IRINA II”, E- wall of the smoker-complex, at the basis of the second mussel-dome from N
25.05.2005	277ROV#7	E- wall of the smoker-complex, at the basis of the third dome-structure from N
26.05.2005	281ROV#3	Mussel-patch at "QUEST" site
26.05.2005	281ROV#12	“IRINA II”, 1m S at the basis of the smoker-complex
27.05.2005	244ROV#10, (Net No 10)	“IRINA II”, 3m NW of smoker-complex, mussel-site 2 (transplantation-experiment)
27.05.2005	283ROV#7	“IRINA II”, E- wall of the smoker-complex, placed in the "Shrimps Gap"
27.05.2005	283ROV#11	“IRINA II”, SE of the smoker-complex, 1m away from its basis
28.05.2005	285ROV#1a	Mussel-patch at "QUEST" site
28.05.2005	285ROV#3	Mussel-patch at "QUEST" site
28.05.2005	285ROV#5	Mussel-patch at "QUEST" site

Appendix 9: ROV dive protocols

Protocol M64-2	***Station: 224 ROV (Dive 50B)***	***sample***
time	***Comments***	***#***
17:00:00	Quest in water; Waterdepth HS: 3053m, no GAPS, positioning only by beacon	
17:38:57	Reaching depth of 600m	
17:55:00	1000m waterdepth	
18:00:57	black screen 1300m	
18:02:14	screen on again, diving on	
18:09:08	reaching 1500m	
18:24:00	reaching 2000m	
18:39:19	reaching 2500m	
18:04:00	reaching 3000m	
18:58:00	seafloor in sight ship position 14°45,22N; 44°58,85W, 3053m	
18:59:00	going to the beacon #12 of M60/3 (still actve) after checking the systems	
19:01:00	sedimens, talus, multivalve-pack o.k.	
19:03:00	heading E	
19:04:00	going 130°	
19:08:00	fish, Ophidiiformes	
19:11:00	comming up to 3025m altitute 24	
19:12:00	bottom in sight again, sediments, 80%, talus, going 299°	
19:15:00	sedimented crusts	
19:16:00	beacon #12 of M60/3 in sight 3045m Ship at 14°45,22N, 44°58,82W	
19:18:00	musselfield and T-logger in sight	
19:22:00	going up to 3039m, heading 166°	
19:24:00	going 44m S, looking for placing the Ocean Bottom Tiltmeter (OPT)	
19:25:00	sedimented crusts	
19:27:00	thruster dust	
19:29:00	clear water again, ROV at bottom 3048m, ship at 14°45,22N, 44°58,83W, HS 3047m	
19:34:00	leaving position, going 299°, thruster dust	
19:36:00	new beacon #14 and OBT will be placed on botton, 3048m ship at 14°45,23N, 44°58,82W HS 3046m	
19:50:00	OBT placed on bottom 3048m ship at 14°45,22N, 44°58,81W HS 3045m, trouble-shooting with rope	
20:06:00	robe is free of OBT	
20:09:00	picking up OBT again, searching for a better position, sediment layer to thick	
20:15:00	going N, thruster dust	
20:16:00	turning S	
20:18:00	Going 300° again	
20:19:00	steep slope sediment covered	
20:20:00	moving 239°, ultramaphic block, talus	
20:21:00	going 320° ridge, flow front structure, strongly sedimented	
20:21:00	fish, Ophidiiformes	
20:25:00	thruster dust holding position	
20:29:00	clear water again, block of crust, 3035m ship at 14°45,24N, 44°58,84W HS 3045m	
20:30:00	OBT placed on bottom 3035m ship at 14°45,24N, 44°58,84W HS 3045m	
20:35:00	going 134°, waiting for clear water, dust sedimentation	
20:41:00	moving 130°, sedimented crust	
20:42:00	thruster dust	
20:44:00	going E back to the mussel field, bacterial mats (?) in sight	
20:45:00	hydrothermal crust, yellow sediments	
20:53:00	placing the beacon #14 3035m ship at 14°45,23N, 44°58,80W HS 3046-3050m	
21:16:00	going E towards IRINA II	
21:23:00	deep blue, 3050m	
21:24:00	seafloor in sight again, strongly sedimented 3052m	
21:27:00	slope sedimented talus going down, 3063, bacterian mats, within the field	
21:29:00	Marker "Anya" in sight, mussel-shill	
21:31:00	shells, brownish sediment	
21:31:00	patches of living mussels	
21:33:00	increasing living mussels surrounded by ultramafic precipitates, going E	
21:34:00	sediments again, no life	
21:34:00	going 142°, shells again	
21:35:00	a lot of dead and living (?) shells, than T- logger of M60/3 in sight, 3037m	
21:39:00	smoker of IRINA II in sight	
21:41:00	active smoker	
21:43:00	going 330°, chimneys in sight	
21:44:00	T-logger, active twin-black smokers, new source (?), shells of mussels at the bottom of old smokers 3036m	
21:46:00	trying to sample black smoke with the fluid-sampling-system (ship position14°45,21N, 44°58,71W, HS 3029m)	
21:57:00	open handel #4 ship at 14°45,21N, 44°58,70W, HS 3032m, ROV at 3036m	224ROV#1
22:02:00	hight T-sensor putting into the black smoke	224ROV#2
22:30:00	removing hight t-sensor, stopped measurement	
22:35:00	closing valve (handle) #4	
22:39:00	T-measurement with 8-channel T-logger	224ROV#3a
22:40:00	removing 8-channel T-logger, thruster dust	
22:45:00	T-measurement with 8-channel T-logger; second try	224ROV#3b
22:47:00	the end of a logger, starting logger recovery	
22:53:00	recoverey successfully finished, placed into the toolbox	
23:03:00	showing and flying around the smoker structures	
23:06:00	diving up to 3021m, to escape the thruster dust	
23:09:00	leaving the bottom, diving up	
23:11:00	TEST of the fluid sampling system; handle #1 open; pump on; position 3 (Flasche 3+4) 2971-2696m	224ROV#4
23:22:00	pump off	
23:29:00	pump on; position 18 (Filter 3+4); 2673-2383m	

23:39:00	pump off
23:46:00	pump on; position 2 (Glasfaserfilter 5+6); 2308-2240m
0:06:00	pump off
1:05:00	pump on 969-689m; position 1 (Flasche 1+2)
1:15:00	pump off
1:15:00	pump on; position 17 (Filter 1+2); 668-362m
1:26:00	pump off; end of TEST of fluid sampling system

Protocol M64-2	***Station: 232 ROV (Dive 51)***	***sample***
time	***Comments***	***#***
8:23	Start of station 232ROV (dive 51), 14°45.18 N/44°58.75 W	
13:14	2840 m, all screens black, software reset	
13:24	all systems working, continue to dive	
13:30	bottom contact at: 14°45,21 N/44°58,78 W, 3037m +5.1m, heavily sedimented talus	
13:35	moving to beacon #12 for positioning	
13:38	moving across sedimented area	
13:45	still moving across sedimented talus	
13:57	still moving across sedimented talus	
14:11	still searching for beacon	
14:17	14°45,18 N/44°58,73 W (GAPS), 3057m + 2.4m	
14:19	whitish sediment cover (?)	
14:20	old rusty tin can	
14:21	moving across talus	
14:28	marker ahead, beacon #12, T-logger from last year	
14:03	stop at beacon #12 (QUEST site)	
14:33	start searching for mussel patch for transplantation experiment	
14:39	mussel-shell in sight	
14:40	mussel patch found with t-logger and bacterian mats	
14:43	going W, leaving the patch, sediment gets coarser (might be pteropoda, thecosomata)	
14:44	going 239°, some single mussels and shells in sight	
14:03	thruster dust, going E	
14:49	going N, thruster dust, turn to E going ahead	
14:03	diving up to 3052 m to escape the thruster dust	
14:51	clear water	
14:55	leaving "QUEST" site, going to IRINA II site, heading E, altitute 3051m+7,4m	
14:59	looking around altitute 3051m+5,2m	
15:02	going 148°, partly thruster dust 3059m+5,6m	
15:07	seafloor in sight, going back to "QUEST" to place the profiler heading 165°	
15:09	bacterian mats in sight	
15:10	shells, slope in sight	
15:11	smoke appears, mussel beds comming up we are within IRINA II, SE part	
15:13	mussel shells in between ultramafic structures,	
15:14	fish, (Ophidiiformes), Matruschca and smokers of IRINA II in sight,	
15:17	going ahead S	
15:18	flying at the bottom of smokers, going to T-Logger, smoke appears	
15:19	at T-logger, holding position 3035m+3,6m	
15:23	zoom in: many scavangers (Phymorhynchus) feeding on Bathymodiolus, no smaller sizes of Bathymodiolus in sight, many Ophiuroidae	
15:29	ROV placed at bottom, starting the transplantation experiment	
15:35	putting the scale beside for better handling the marker (T-logger) and profiler	
15:40	start to remove the profiler	
15:44	profiler is placed on the mussel bed, shrimps and Phymorhynchus	232ROV-1
15:54	t-logger placed within the musselfield ;T°max:4,6°C	232ROV-2
15:57	t-logger removed	
16:04	valve #3 of fluid-sampler opened	
16:10	fluid sampler nozzle at surface of mussel bed, below profiler	
16:12	pump on with medium power (approx. 22VDC) pumping max. 5cm above the field	232ROV-3
16:16	fish, (Ophidiiformes)	
17:01	still pumping	
17:05	Pegasus zoom in shimmering water: Segonzacia cf. mesatlantica, Rimicaris, Pantopoda, Ophiuroidea, among Bathymodiolus and Phymorhynchus	
17:07	end of fluid sampling	
17:15	starting to replace the profiler	
17:21	profiler is placed besides the mussel bed	
17:24	close vavle #3	
17:27	placing the 7 nets from the poarch, laying down besides the musselfield	
17:32	starting the searching for a better mussel-patch to locate the profiler again	
17:36	going S around the smoker complex	
17:36	going further S, mussels shells within live specimens	
17:39	looking around the smoker-complex,moving back, heading 124° up to E	
17:45	accident sampling at smoker	
17:46	less shrimps at the smokers than during M60/3 ???	
17:47	zoom in on the musselfield at the bottom of the smokers. Bathymodiolus specimens coated with brown layer	

17:49	fish, Zoaceres in sight	
17:49	starting T-measuremt with T-logger in between mussels, surounded by shrimps (Mirocaris ?)	
17:55	nice sequence of Zoaceres	
18:02	end of T-measuremet: T1 47°C (bottom 1cm); T2 39°C; T3 26°C; T4 22°C; T5 26°C; T6-T8 callibration error (every 1cm measured)	232ROV-4
18:05	going back to the first experiment site, to take up the profiler	
18:09	taking up the profiler	
18:18	lots of snails	
18:21	putting down the profiler	
18:22	Profilur on ground	
18:23	problems with balancing the profilur	
18:30	going back to first site	
18:36	collecting nets from first site	
18:41	collecting mussle sample with net #7 from first site	232ROV-5
18:50	positioning T-logger #4144 at the spot where mussles were removed (first site)	232ROV-6
18:57	net #7 placed into large box #7	
19:07	collecting ruler from sample point	
19:10	collecting other nets from first site	
19:31	10m westward from second site; dropping all the empty nets	
19:48	placing ruler at second site	
19:51	Nozzle of fluid-sampler broken by removing out of the tube	
19:55	open handle #4 (KIPS)	
20:02	trying to handle the nozzle	
20:04	nozzle of fluid-sampler placed in source of shimmering water	
20:38	detailed study of fish lying next to nozzle	
20:48	moving nozzle out, pumps off, changing nozzle from Orion to Rigmaster	232ROV-7
20:51	closing handle # 4	
20:56	opening handle # 2	
20:57	Orion takes nozzle again from Rigmaster and placing into musselbed	
21:00	pump ON, pumping Mirjam's filter, same position as 232ROV#7, at the end of ruler	232ROV-8
21:16	pump OFF	
21:23	nozzle in parking position	
21:34	closing handle # 2	
21:34	starting to move Profiler into upright position	
21:38	profiler in position, recording, but ruler was moved from previous position	
21:54	all recording done, photos taken, packing Profiler	
21:59	Profiler on the porch of ROV, securing with Rigmaster and Orion	
22:01	leaving site, going up, end of dive	
23:00	ROV on board - end of station	

Protocol M64-2 time	Station: 244 ROV (Dive 52) Comments	sample #
	ROV in water, ship's position: 14°45,11'N, 44°58,69'W, depth 3015m, on board: profiler, ocean bottom pressure meter (OBP)	
13:21	bottom sight, 14°45,18'N, 44°58,76'W, water depth 3027m + 13,1m sediment covered talus	
13:24	moving to mussel field at IRINA II, place profiler there	
13:25	patch of mussel shells	
13:30	thruster dust	
13:32	heavily sedimented area	
13:34	talus with sediment in between	
13:40	still moving, about 13 m above ground	
13:41	sitting above IRINA II, positioning to beacon #12, moving direction 120°	
13:46	fish	
13:50	outcrop area	
13:53	patch of mussel shells	
13:56	more mussel shells	
13:56	IRINA II directly in front with two markers	
13:58	thick black smoke emanating from small chimney	
14:00	moving around Irina II central structure, Nicole's nets in sight	
14:06	arriving at mussel bed, depositing profiler	
14:27	still at site, turning profiler on the side, getting a better grip with Orion	
14:45	positioning profiler on its side	
14:50	finished deposition of the profiler	
15:07	beginning the deposition of the profiler again; upright; near the ruler	
15:14	finished deposition of the profiler near the ruler on the mussle patch (site 2)	244 ROV-1
15:15	leaving towards the spot where the OBT is; going W	
15:23	moving across sedimented talus	
15:26	rocky area, patches filled with pteropod shells	
15:27	reddish-brown colored sediment	
15:28	intense yellow and brown staining	
15:29	white bacterial mats, black smoker in the back	
15:30	thick talus area	
15:31	holothuria in sight	
15:32	vast sedimented area	
15:34	talus with sediment in between	
15:35	tin can in sight	
15:37	rocky area	
15:39	arriving at site for positioning OBP	
15:48	OBP in position, ship's position: 14°45,22'N, 44°58,77'W	244 ROV-2
15:56	moving across white bacterial mats	
15:57	beacon #14 in sight	
16:03	OBT in sight	
16:12	OBT was picked up, placed on porch for transit to final position	
16:18	picking up beacon #14 with Rigmaster, moving to site where OBP stands	
16:29	fish approaching ROV	
16:32	water column above OBP site filled with dust	
16:42	still searching for proper position for OBT	
17:01	sitting next to tin can	
17:35	water column filled with dust	
17:37	OBT (ocean bottom tiltmeter) placed on ocean floor next to beacon #14	
18:07	searching for OBP, going 325°	
18:09	searching for OBP, going 46°	
18:11	searching for OBP, going 178°	
18:12	going 297°	
18:17	back at beacon #14	
18:24	given up looking for OBP;	
18:37	GAPS Position von Beacon #14: 14°45,212 N, 44°58,796 W , going N	
18:41	going back heading 144° up to 110°	
18:41	stopped again, looking around	
18:42	going further to 110° up to 182°	
18:45	going E	
18:53	placed OBT on ultramafic talus 3051m	
19:02	levelling OBT	
19:09	OBT levelled GAPS 14°45,201 N, 44°58,784 W	
	y-orientation 48°E	244 ROV-3
19:17	leaving OBT site	

19:20	leaving for beacon #14	
19:29	picking up beacon #14 with Rigmaster, moving to site where OBT stands	
19:32	diving u to 3036m+16m, going E	
19:33	going down again, heading E, found OBT, 3047m+3,0m	
19:35	placed Beacon No 14 nearby OBT, 3m SSW, 3050m, Position (GAPS): 14°45,199 N, 44°58,783 W	244 ROV-4
19:44	going to IRINA II, heading 112° up to 137°	
19:50	flying across sediments and ultramafic talus, actinaria	
19:57	sediments with single shells, sediments color change to yellow, 3043m	
20:00	stopped and looking around, oriantation lost ????	
20:02	going on 156°, sedimented talus, big block	
20:04	stopped again, looking around facing N, flying N	
20:05	fish, Ophidiiformes	
20:06	sediments increasing, two large talus blocks	
20:07	flying on, heading 315°	
20:08	sediments, big talus block going on to W	
20:10	one single Bathymodiolus on talus, sediment covered	
20:11	sediments with big talus block	
20:11	shells increasing, going S	
20:12	field is found, dead shells	
20:13	profiler in sight, felt down, lying at side, nets in sight	
20:17	beginning the photomosaicing	
20:22	DSPL recording for photomosaicing	
20:24	starting the photomosaicing going E first record	
20:26	moving back, second record	
20:27	moving forward again, third record	
20:28	showing up to the smoker-complex	
20:29	fourth photomosaicing	
20:33	photoshooting with scorpio, with scale as well lasers	
20:39	collecting nets from holding point, then move to sampling site	
20:54	Orion grabs net #5	
20:56	net back on porch	
20:57	lid of net #5 now open	
20:59	difficulties to securely grab net	
21:01	net #5 now in the right position in Orion manipulator	
21:03	net #5 successfully sampled thereby stirring up mussels	
21:06	resampling net #5 causing black cloud of dust	
21:08	sample finally taken	244 ROV-5
21:10	lid closed	
21:12	net #5 positioned next to sampling site	
21:15	net # 6 grabbed	
21:16	sampling causes black dust again	
21:17	sample taken	244 ROV-6
21:19	net #6 placed on porch	
21:19	net #3	
21:22	while trying to sample mussels net #3 melted partially	
21:25	net #3 can not be used anymore	
21:29	next net grabbed (#4)	
21:31	sample taken	244 ROV-7
21:33	lid of net #4 closed	
21:39	now net #2	
21:41	sample taken	244 ROV-8
21:41	lid of net #2 closed	
21:44	net #8 grabbed	
21:47	sample taken	244 ROV-9
21:49	lid of net #8 closed and placed on porch	
21:57	moving nets on ROV porch	
22:07	net #? grabbed	
22:11	attempting to sample however lid is not fully open	
22:13	lid is now fully opened	
22:22	obviously something wrong with net (melted?)	
22:25	ROV back to get remaining 2 nets from storing location	
22:28	the 2 nets stick together, trying to separate them with second manipulator	
22:30	reason for sticking together is cable ties	
22:31	nets separated	
22:37	back to sampling location	
22:42	first and second attempt to sample mussels failed	

22:45	a few mussels now in net	
22:46	and may be one more	
22:50	net # is 10	
22:51	lid of net #10 closed and placed on porch	244 ROV-10
22:53	sampling of all nets finished, now looking for a location to place the nets for the coming days	
23:06	location close to tilt meter with marker found	
23:10	starting to unload nets and placing them on rocky ground	
23:13	two nets unloaded	
23:15	third net placed	
23:17	fourth net placed	
23:18	fifth net placed	
23:22	putting unused and broken nets in sampling box	
23:37	decision to abort dive due to leaking camera	
1:40	ROV on Board - end of station	

Protocol M64-2	***Station: 249 ROV (Dive 53)***	***sample***
time	***Comments***	***#***
12:19	ROV in water, ship's position: 14°45,16'N, 44°59,06'W, depth: 3050m	
14:15	bottom sight, water depth: 3025m + 7m, ship's position: 14°45,21'N, 44°58,78'W	
14:15	move to beacon #14	
14:30	talus with sediment inbetween	
14:30	arriving at site with beacon #14, OBT, mussel nets	
14:35	checking leveling of OBT, everything is ok	
14:38	approaching Nicole's nets	
14:42	collecting mussel net #4 (sample No: 244ROV-7) in large box #7	
14:50	leaving for IRINA II	
15:11	arriving en-route at white square marker "ANYA"	
15:13	Grenadierfisch	
15:14	thick mussel patches	
15:15	arriving at IRINA II, profiler lying on the side	
15:27	start positioning 8-channel-temperature logger at site where mussels have been collected	
15:29	temperature measurement 30 cm in mussel bed: 7-8 °C	249 ROV-1
15:33	T at tip: 8°C, 10 cm above: 12°C, values remain constant	
15:35	T at tip: 8.7°C, 10 cm above: 11.7°C, 9°C at surface	
15:37	second position about 20 cm NW, deeper in mussel bed	
15:38	T at tip: 16°C at depth, 6°C at surface	249 ROV-2
15:40	third position, 20 cm E, deeper in mussel bed (50 cm)	
15:42	T at tip (45cm): 21 °C, 41 cm: 7-8°C, 35 cm 17-18°C	249 ROV-3
15:47	measuring again at site where mussels have been removed, hard surface	
15:58	T measurement at tip uncovered by mussels, only covered by ophiuroidea (2 cm in mussel bed, hard crust underneath): 2.7 °C, seawater: 2.6°C	249 ROV-4
15:58	terminating T measurements, start sediment sampling	
16:06	taking shovel with lit from box #6	
16:08	try to collect a bio and sediment (?) sample from site 249 ROV-4, 3036m	
16:14	no sediment at this tip, unsuitable place, searching for a better one	
16:16	trying to sample 30cm right of the tip before, unsuccessful	
16:19	secound try more or less successful, tool was not suitable for this sampling goal, single mussels were removed and shifted beside, shovel replaced in box #6	249 ROV-5
16:29	t-logger # 4143 stuck in between experimental patch of mussel site II	249 ROV-6
16:40	end of mussel experiment, going for hot fluid-sampling to ANNA LOUISE heading 155°	
16:43	flying across ultramafic talus, covered by sediments	
16:43	bacteria mats in sight	
16:44	gap in the sediment, possible from TV-grab 239?, covered by white sediments (bacteria or anhydrit?)	
16:48	approaching site "B", 2977+5,4m waterdepth	
16:50	little smoker / smoking crater	
16:53	some ultramafic outrcrop and blocky talus	
16:55	sulfide sediment	
16:56	approaching site "IRINA I", grab-mark	
16:57	sulfide-talus, -crusts and Fe-oxides	
16:59	arriving "ANNA LOUISE"	
17:03	flying from south arround "ANNA LOUISE" and arriving again from east	
17:11	end of surrounding "ANNA LOUISE" and arriving again from NNE	
17:15	smoking crater in sight - min.4 vents / fish: Bythitidae	
17:20	only few biota, some death mussels, crab	
17:28	try to go to little smoker in center of the crater	
17:36	may the candelabra-smoker	
17:40	try to go to smoker ~2m west of proposed candelabra to sampling hot fluid	
17:58	change of pilots	
18:00	seaching for a better position	
18:06	try to sample the fluids, first try at 2938,5m	
18:12	open handle No1	
18:18	nozzle placed into the smoker source	249 ROV-7
18:18	pump on, at least pumping for 45 up to 60 min	
19:07	stop pumping	
19:16	changing position slightly to close handle # 1	
19:38	measuring temperature fluid of sampled smoker T1 (held in chimney) 123°C, 150°C, 160°C, 151°C; measuring temperature a second time T2: 140°C, 150°C, 160°C, 172°C, 180°C, 185°C, 187°C, 201°C, **205°C**	249ROV-8
19:46	very few white shrimps; crab	
19:56	trying to sample a little bit of chimney structure-aborted; shrimps in picture	

19:56	leaving ANNA-LOUISE and flying to IRINA I for second fluid sampling	
20:05	arrived at "B"	
20:15	arrived at IRINA I	
20:25	searching for a good position to sample hot fluids from chimney structure (2950m)	
20:25	change of pilots	
20:27	open handle # 3	
20:29	nozzle placed into smoker source; crab, very few shrimps	
20:29	pump on	
20:32	pump off changing position of nozzle	
20:33	nozzle placed into smoker source	249ROV-9
20:33	pump on, at least pumping for 45 up to 60 min	
20:49	still pumping, measuring other chimney structure; it is 2-3m away N, 20cm in diameter, 60 cm high and shimmering water is coming out of base ; field has 3 active, 2 inactive smokers at this site; looking candelaber like; microbial mats	
21:17	stop pumping	
21:18	close handle # 3	
21:20	open handle # 2 in order to pump on large filter	
21:21	start pumping, single shrimps	249ROV-10a
21:24	pump off because slipped off of chimney opening	
21:29	diving up to escape the smoke and the thruster dust to 2940m	
21:32	second run begins	
21:35	smoke is going to SW	
21:35	nozzle placed into the smoker source, pump on	249ROV-10b
21:50	pump of, 0,7A Power o.k.	
21:53	close handle # 2, nozzle replaced into the tube	
21:57	starting T°-measurment, big opening: 130, 160, 175, 182, 186, 187. Little opening: 123° , T max: 188°	249ROV-11
22:01	stop T-measurement	
22:06	fying to IRINA II heading 331°-335° 2987m+24m	
22:21	going down to 3000m +10m	
22:24	changing direction to W, seafloor in sight, sediments with rocks 3006m + 8m	
22:28	going deeper 3015m +8m, heading still W	
22:30	seafoor in sight again 3022m +4m, Sedimets and talus, single mussel patch	
22:32	slope with sediments and large talus block	
22:34	strongly sedimented ultramafic talus, heading still W	
22:35	going to 213°	
22:37	looking around, orientation lost?	
22:41	flying to 220°, seafloor is changing	
22:42	again sediments with talus	
22:46	sedimented ultramafic talus	
22:50	stongly sedimented slope with talus	
22:53	going W again	
22:55	going E following slope upwards	
22:56	lost bottom contact 3007m, no Altitute (>35m)	
22:58	lost beacon contact, stopp searching for musselfield at IRINA II, diving up	
0:59	ROV on board - End of station	

Protocol M64-2	Station: 252 ROV (Dive 53)	sample
time	Comments	#
11:15	ROV in water, ship's position: 14°45,03'N, 44°58,69'W, depth: 3001m	
12:58	bottom sight, 2951+6.8 m, ships position: 14°45,07'N, 44°58,71'W	
13:10	seafloor in sight, E of ANNA LOUISE, sediment-covered talus	
13:12	moving in SW direction to southern rim of ANNA LOUISE, trying to locate Candelabrum, positioning beacon somewhere in that area	
13:16	crossing large sedimented area	
13:22	fish: Ophidiiformes	
13:23	moving direction N-NE, large blocks, (?) rim of ANNA LOUISE	
13:26	talus, some larger blocks	
13:29	carser sediments 2970m+3,2m, heading still N	
13:31	signal from beacon #12 received, try to positioning to beacon, 2072,5m	
13:33	going W	
13:35	going 33°	
13:36	single actinian sitting on a talus block, sediments	
13:37	sediments getting coarser again, track of russian cable (?) 2983m	
13:39	going N	
13:40	track of cable again in sight	
13:40	block of talus, ridge like formation	
13:41	fish lying on the bottom (strange, ventral fins two pairs positioning like legs)	
13:46	colored sedimets, hydrothermal character, TV-grab station	
13:47	brownish sediments, ultramafic talus	
13:48	single shell, Ophidiiformes, colored sediments	
13:49	nice ultramafic structures , 2057m	
13:50	hit the point, mussel-shells increasing, sulifide-mound	
13:51	black smoke in sight, 2952m, moving to the smoker,	
13:54	moving parallel E, towards the other smokers, crabs and some mussel in sight	
13:55	shifting the position going from south to the smokers	
13:57	nice smoker, zoom in, looking W, E-site the structure	
13:58	we are at IRINA I	
14:00	going 67° at the crater rim	
14:03	we are at the smoker, at which we sampled fluids during 249ROV , same smoker as at 13:51	
14:07	going E W-view of the smokers	
14:11	large musselpatch, heading S	
14:12	going W, to place one marker	
14:14	over the musselfield again, heading S, 2050m	
14:25	positioning to beacon #11, water depth 2949.4 m, ships position 14°45'07 N, 44°58'69, target #23 in ROV DVL	target23
14:33	probably not in IRINA I to check it, going 30m S if there is nothing, than we were at ANNA LOUISE, if we hit another site, than were at IRINA I	
14:36	hit ANNA LOUISE, beacon # 11 stands in IRINA I	
14:37	strong current, going to S, direction N to S, 2939m	
14:41	photoshooting of a nice smoker at ANNA LOUISE, S-view of the structure	
14:43	flying S along the crater rim	
14:45	going 131° (SE) along the rim	
14:49	candelabrum (?) in sight	
14:56	leaving ANNA LOIUSE, start mapping Site A, first 125m direction 150°	
15:00	much sediment, little talus	
15:02	heading 153°	
15:11	small structure, altered sulfides (or old TV Grab hole), surrounded by sediment	
15:12	large blocks	
15:16	first turning point: moving 10 m direction 60°,	
15:18	second turning point: moving 80 m direction 330°	
15:21	third turningpoint approaching, slope of colored weathered ultramafic sedimens	
15:22	hit site "A", old aktive smoker, chimney aprox. 7-8m height, diamater 1m - 1,5m, crabs and single mussels at the bottom	target 24
15:26	DVL coordinates 14°45,047 N, 44°58,671W, 2931m	
15:29	accident sampling, 50cm lost of chimney	
15:30	fish Bythitidae	
15:32	going 10m NE, following the track	
15:33	third turningpiont, going 150°	
15:35	sediments, weathered old ultramafic rocks, steep slope	
15:36	strongly weathered ultramafic and hydrothermal structures	
15:36	sediments again, 2913m	
15:37	sediments and ultramafic talus, fourth turningpoint, going to 60° for 10 m	
15:39	fifth turningpiont 80m going 330°	
15:44	going deeper, 2935m, from container: seventh waypoint, (sixth turningpoint) 10m to 60°	
15:51	sediments, stopped, facing 151°, 2935m	
16:02	Turningpoint 8: going 151°	
16:05	sediments	
16:09	turningpoint 9, 10m 60° ENE	
16:10	turningpoint 10, 80m 330°WNW	
16:11	sediments	
16:14	sediments with ripples	
16:15	turningpoint 11, 5m 60° ENE 2935m	
16:16	tuningpoint 12, 5m 150° SES, going a track that should cross site A like sketched in map but did not cross	
16:17	sediments with ripples	
16:19	sediments without ripples	
16:19	ultamafic talus, some fragments	
16:21	ultamafic talus, blocks and sedment with ripples	
16:23	turningpoint 13, 8-10m, 60°	
16:25	turningpoint 14, 7m, 330°NWN, 2912m	

16:26	ultamafic talus, some blocks	
16:28	ultamafic talus, blocks and sedment with ripples	
16:28	turningpoint 15, 7m, 60°, 2933m	
16:29	ultamafic talus, blocks, framents	
16:29	truningpoint 16, 150°,2932m	
16:30	ultamafic talus, blocks framents	
16:31	ultamafic talus, larger blocks, framents, few sediments with ripples	
16:33	sediments, few blocks of talus	
16:34	turningpoint 17, 7m, 60° ENE, 2900m	
16:34	blocks of talus	
16:35	turningpoint (TP) 18, 7m, 330°, 2900m,	
16:36	ultamafic talus, blocks, framents	
16:38	ultamafic talus, blocks, framents and sediments	
16:39	end of mapping at north-east corner of mapping area, 2930m, going to the "tower" smoker, target 24	
16:41	60m 230° to the tower, target 24	
16:49	going to 60°ENE, 2935m	
16:52	...355° NWN, 2935m	
16:53	...33° NNE, 2935m, searching chimney with sonar	
16:56	…150° SSE, 2935m, searching …	
16:57	… 180° S, 2935m, searching …	
16:58	… 240°WSW, 2935m, searching …	
17:00	… 307°, WNW,2935m, searching …	
17:01	… 275° …	
17:02	… 218°, …	
17:04	smoker of site "A" in sight, ROV facing 218°. NE-site of chimney, 2931m	
17:06	fish: bythitidae	
17:09	measuring distances to beacon #11 + #12	
17:14	fish: bythitidae	
	dist. to beacon #11: 93 m to 278° , to beacon #12: 480 m to 300°	
17:26	marker "MB" ("Meteor-B", white dish with two white cable ties) deployed at top of the talus mound of smoker at site "A"	
17:36	try take a sample from basis of smoker with rig-master- fragment of sample placed on porch in front of atlas camera, fish	252ROV-1
17:42	photo mosaicing of smoker, target 24, view in direction 140° SE, with ATLAS camera on tape B5	
18:03	view direction changed to 60° ENE	
18:04	top secton of smoker: shrips, vent crab	
18:08	view direction changed to 120°	
18:08	view direction changed to 295°	
18:10	end of photo mosaicing, no further samples here, going to site "IRINA 1"	
18:12	site "ANNA LOUISE"	
18:24	Marker "M4" in "ANNA LOUISE" ("Meteor-4", white dish without cable ties) deployed at smoker target 249ROV-7, 2940m	
18:28	in direction °0 N to "IRINA 1"	
18:30	fish	
18:30	direction 270° W	
18:32	arriving at beacon 11, 2950m, at site "IRINA 1"	
18:47	sample of older sulfid talus from site "IRINA1", placed in sample box mid/front Nr.2	252ROV-2
19:00	arriving at smoker 249ROV-9 in "IRINA1"	
19:01	Marker "M5" in "IRINA1" ("Meteor-5", white dish without cable ties and with blue rope) deployed west of smoker target 249ROV-9, 2952m, diffusive venting at this place	
19:03	shimering water, vent crab, rock sample of anhydrite in box front/right Nr.3	252ROV-3
19:08	With "Ankes Schaufel", grey sediment sample from border of crater "IRINA1" in box Nr.6	252ROV-4
19:17	another rock samples from the same place like before in box Nr.1, front/left	252ROV-5
19:20	moving around	
19:21	moving to loansome mussels at the OBT	
19:43	flying at a waterdepth of 2954m heading W, altimeter out of range	
19:48	changing direction to N	
20:01	changing direction to 241	
20:10	changing direction to N, 2971m, altimeter out of range	
20:13	going deeper, heading 252°	
20:16	holding depth at 3042m+ 8,3m	
20:17	seafloor in sight, heading 226°, beacon #14 and OBT in sight	
20:23	starting recoverey of net # 6, Vent lobster: Munidopsis in sight	
20:37	net # 6 packaget	244 ROV-6
20:38	try to make some pictures of Munidopsis	
20:40	making some pics of "mussel-cementary"	
20:42	flying to SE (heading 131°), depth 3049m	
20:46	changing directory to 110°	
20:49	changing directory to 90°	
20:50	changing directory to 268°	
20:52	IRINA II in sight	
20:58	try to get mussel samples with new net # 9	
21:00	finishing mussel-sampling	252 ROV-6
21:02	go to pick up the profiler (244ROV-1)	
21:06	moving away from IRINA II to close the Niskin bottle	
21:16	swirl up to much dust, go a little higher, Profiler on bottom	
21:21	find profilur again	
21:25	closing Niskin	
		252 ROV-7
21:27	pick up profiler again	
21:31	finishing profiler loading	
21:35	off bottom - starting emerging	

Protocol M64-2 time	Station: 257 ROV (Dive 55) Comments	sample #
	Atlas HiRes camera dismounted, DSPL and Pegasus cameras will be video	
12:38	taped.	
13:40	bottom sight: 14°45,19'N, 44°58,74'W, depth: 3030+2.7 m, near IRINA II	
13:44	sedimented talus, some large blocks	
	DSPL upper left, VCR tape B, Pegasus upper right VCR A, overview camera	
13:49		
	mussel patch and white patch and thick bacterial mats + jelly like object (?)	
13:53	measuring position relative to beacon #14	
14:03	fish	
14:05	large sediment covered area	
14:06	small mussel patch with fish	
14:07	large mussel patch	
14:08	large area covered with thick white bacterial mat, likely a different type than observed at 13:49	
14:09	measuring position relative to beacon #14: 130m in direction 150°	
14:18	moving to beacon #14	
14:23	mussel patch	
14:24	arriving at IRINA II	
14:31	surveying the entire musselfield for positioning the T-loggers	
14:38	positioning 10 T-logger along a temperature gradient from NNW to SSE, starting at the white flote positioned on the mussle field at large chimney	
14:49	positioning t-logger with a distance of ca. 50cm to each other; starting with t-logger #0 (ca. 50cm W (?) from t-logger #4143) continuing with t-logger #1, #2, up to #4 ; going from t-logger #4143 (NNW) towards SSE	257ROV-1a, -1b
15:18	T-logger #2 placed	257ROV-1c
15:23	T-logger #3 placed in some big mussels layed up site down with opened shells	257ROV-1d
15:26	T-logger #4 placed	257ROV-1e
15:32	beginning to place the following T-loggers W-wards in a parallel line, distance 1m to the eastern (first) line	
15:45	T-logger #5 dropped on the bed parallel to T-logger #4	257ROV-1f
15:48	T-Logger #6 stuck into the bed	257ROV-1g
15:52	replacing T-logger #5 as second logger after logger #6 in line	
15:54	placing T-Logger #7 after #5	257ROV-1h
15:59	placing T-Logger #8	257ROV-1i
16:05	placing T-Logger #9	257ROV-1j
16:05	releasing starboard niskin T=2,7°	257 ROV-2
16:06	releasing middle niskin T=2,7°	257 ROV-3
16:06	releasing port niskin T=2,7°	257 ROV-4
16:10	T-measurement with 8-channel T-logger	257 ROV-5
16:13	second try	
16:16	third try	
16:16	fourth try	
16:17	end of T-measurement (T= 3.4°C)	
16:24	positioning the acoustic marker, beacon #13	
16:38	collecting T-logger #4143	
16:48	pilot change	
16:57	positioning from beacon #13 to beacon #11, #12 und #14	
16:58	going to site "B"	
17:00	position from beacon #13 to beacon #12 is 303° and 144m	
17:02	position from beacon #13 to beacon #14 is 330° and 78m	
17:02	taking turn out of wire	
17:19	arrived on seafloor (3044m)	
	back to IRINA II, beacon #13 and t-loggers, going south and than south-	
17:20	west	
17:27	found thick white bacterial mat, taking sample with Anke's shovel	
17:35	sitting ROV on ground, new positioning of shovel in the orion	
17:36	taking sample of white bacterial mat; shimmering water observed	257ROV-6
17:49	put shovel in box 5	
	measuring temperature in bacterial mat 27°C with 8-channel T probe	
17:52	channel 4	257ROV-7
18:02	positioning of bacterial mat: from bacterial mat to site "B" 93m 126°	
18:05	going towards site "B"	
18:18	repositioning	

18:20	arrived at site "B", circling site "B" to find smoker on outer rim	
18:22	two active chimney structures are visible, going NW	
18:31	SE of crater occurs a mussel shill patch, single srimps at the smokers, on the periphery of the smoker actinia	
18:32	handle #1 opened	
18:32	nozzle of fluidsampling system stuck in the smoker hole	
18:34	started pumping from larger structure	257ROV-8
18:47	smoke flows out of the outlet tube of pumping system	
19:04	still pumping	
19:06	water depth at this place 2979.0m	
19:13	GAPS position (?) of the sampled smoker 14,45.1092 N, (44,57.489 W -	
19:28	crab	
19:33	pump off, closing handle #1	
19:36	handle #1 closed	
19:39	handle #2 with Mirjams filter opened	257ROV-9
19:39	nozzle inserted in smoker, pump on	
19:42	crab of 5cm width	
19:49	ROV slightly moved, nozzle out of chimney - pump off - nozzle reinjected -	
19:50	ROV slightly moved again - pump off, nozzle out of chimney - nozzle reinjected, but not as good as before, possibly surrounding sea water in filter, pump off	
19:53	again nozzle out of chimney - reinjected - pump on	
20:08	electrical pump current raised from 0.8A to 1.0A	
20:17	nozzle out of chimney, pump off, pump current at end 1.1A	
20:20	handle #2 closed	
20:33	set of "Svenonator" (particel catcher + t-logger)	
20:45	measuring temperature and catching particles for 5 minutes	257ROV-10
20:50	stopping the "Svenonator"	
21:03	placing "Haraldonator" on smoking chimney	257ROV-11
21:06	finished sampling particles	
21:12	deposition of marker (Marker MA) at sampled vent	257ROV-12
21:17	collection of old sulfides and pieces of chimney structure	257ROV-13
21:18	put sample into Box1	
21:31	collecting another sulfide piece, greyish, placed in box 1, 2978,4m	257ROV-14
21:38	leaving bottom, diving up	

Protocol M64-2 time	Station: 261 ROV (Dive 56) Comments	sample #
13:18	bottom sight: 14°45,08'N, 44°58,69'W, depth: 2949+5.3 m,	
13:20	at beacon #11, IRINA I	
13:25	positioning according to different beacons	
13:26	from beacon #11 to beacon #13: distance 265m, heading 330°	
13:27	from beacon #11 to beacon #12: distance 389m, heading 300°	
13:27	from beacon #11 to beacon #14: distance 345m, heading 330°	
13:30	moving to Site A, searching with sonar	
13:35	moving across sediment	
13:36	whitish surface patches	
13:37	small rocky and brownish colored mound, also some white patches on it	
13:40	rocky surface, ?weathered ultramafics	
13:41	Barad-Dur at Site A directly in front	
13:42	mosaicing from N	
13:45	tape A DSPL, tape B Pegasus	
13:47	move marker out of picture	
14:08	first fotomosaic from N to S, second one (with shrimp in picture) from E to W	
14:09	now with Scorpio again from N to S	
14:10	looking at the NW side	
14:15	measuring position relative to beacon	
14:21	Site A to beacon #11: distance 96m, heading 300°	
14:22	Site A to beacon #13: distance 360m, heading 320°	
14:23	Site A to beacon #12: distance 487m, heading 310°	
14:25	trying fluid sampling	
14:28	handle #1 open	
14:48	pump is running since 14:29, impossible to place nozzle into chimney, structure too fragile, pumping fluid from top part of structure within thick smoke cloud (will be diluted with seawater)	261ROV-1
15:10	still working on fluids	
15:21	finish fluid sampling, total pumping time 15 minutes, two fishes (Bythitidae) at the bottom of the tower	
15:25	starting to close Niskin bottles	
15:26	closing front port site Niskin, background water sample	261ROV-2
15:30	three Bythitidae fish, taking nice pictures	
15:40	collecting freshly broken chimney piece, which fell down from the top, placed into box No.1	261ROV-3
15:42	second piece, putting again into box No 1	261ROV-4
15:45	laser focused in, distance 20cm, moving up	
15:49	going to IRINA I directly towards beacon #11, heading 306°	
15:51	crossing over colored sedimented ultramafic structures parallel to a slope	
15:55	arrived at beacon #11, old smoker-complex, mussel bed	
16:00	moving toward the marker, nearby the sampled smoker	
16:08	searching for smoker on crater rim which was sampled for fluid during cruise M60/3 (sample # 53ROV)	
16:12	first move back to beacon #11 for sampling the mussel field	
16:25	beacon #11 left side of picture, looking N, large mussel field directly ahead	
16:31	most mussels are *Bathymodiolus* but many are dead, still wanting to collect a sample	
16:32	taking net from box #2, start sampling	
16:38	mussel field describes a half circle, open to the E, may be around a former fluid source	
16:56	mussel sample collected from three different spots in this mussel field, sample net placed in box #2	261ROV-5
17:09	located the chimney which was sampled during M60/3	
17:13	fluid sampling, nozzle out	
17:17	opening handle #4, filling five bottles	
17:20	pump on	261ROV-6
17:25	pump off	
17:26	pump on again	
18:22	pump off	
18:41	closing handle #4	
18:42	opening handle #2, pumping through Mijam's filter	
18:50	positioning nozzle into chimney	

18:53	pump on	261ROV-7
18:58	pump current 0,8-0,9A	
19:29	pump off	
19:30	back row, port site niskin, background water	261ROV-8
19:30	back row, centre niskin, background water	
19:38	closing handle #2	
19:47	placing marker MD	
19:47	closing Niskin starboard bottle in front row (in smoke)	261ROV-9
19:53	collecting beacon #11	
19:57	last Niskin bottle (back row, starboard bottle) closed in water column	261ROV-10
19:57	removing T-logger from parking position	
20:00	T-measurent: at discharge, flat lying device: 108°, 135°, 164°, 173°, **200°**, 182°, 174°, 167°	261ROV-11
20:03	end of station, diving up	
	sulfide sample on porch	261ROV-12
	atacamite samples on porch	261ROV-13

Protocol M64-2	***Station: 263 ROV (Dive 57)***	***sample***
time	***Comments***	***#***
13:15	ROV in water, ship's position: 14°45,10 'N, 44°57,70 'W, depth: 3025m	
14:50	reaching 2000m	
15:31	bottom sight, ship's position: 14°45,12 'N, 44°58,67 'W, depth: 3002+2.9m, HS 2995m	
15:33	moving to Site from SW side	
15:43	moving across sediment, several areas with colored hydrothermal sediments	
16:19	problems with orientation, moing back to beacon #13 at IRINA II	
16:46	going now to beacon #14, recovering one mussel-net and controlling OBT, following by searching for Marker "ANYA"	
16:49	approaching beacon #14	
16:53	OBT still in position and leveled to < 2°, orientation of the short axis approx. 89 °	
17:06	collecting net # 2 of musselbed experiment (244ROV-8), on porch	
17:23	moving to marker ANYA, moving E	
17:26	going N	
17:40	arriving at large musselfield, 3053m depth, shells of Bathymodiolus and shells of Calyptogena,snails	
17:44	marker ANYA (name underlined)	
	positioning with respect to beacons	
17:53	Anya to beacon #12: distance 114m, diection 288°	
17:53	Anya to beacon #13: distance 33m, direction 120°	
17:53	Anya to beacon #14: distance 51m, direction 328°	
18:08	placing beacon # 11 at ANYA site	
18:28	wanting to collect push cores at this site	
18:30	checking bacterial mat	
18:47	first pushcore taken, but sediment fell out	
18:49	pushcore (# 2 from Jens Stecher) successfully taken	263ROV-1
18:52	taking another pushcore	
18:56	pushcore (yellow handle from Jens Stecher) successfully taken	263ROV-2
18:58	sediment	
19:04	at this site taking Niskin-bottle # 4 (middle/front row)	263ROV-3
19:08	marker ANYA in sight, photo taken, beacon SE of marker ANYA	
19:11	next to beacon: rusty rocks, small mound with mussels, snails, Schlangensternen	
19:12	searching for live Calyptogena mussels	
19:18	up the slope live mussels with shimmering water, also: marker C from Gebruk paper, depth 3050m, red+purple colored surface	
19:29	larger musselbed, 3045m, photo taken	
19:38	collecting mussel sample, presumably *Calyptogena* , in box	263ROV-4
19:47	outcrop as described by Gebruck	
19:50	Marker "Irina Microsmoke 1995" 3040m	
20:07	arriving at beacon #13 and temperature loggers	
20:07	picking up the mussel net (**244ROV-5**) for Jens, placed in box	
20:09	crab in net	
20:16	leaving beacon #13, going in west direction	
20:20	arriving at a musselpatch with an overgrown temperature logger # 3	
20:21	Temp-logger #3, the beacon has been fallen down during the last three or four days	263ROV-5 ??
20:29	arriving at smoker in QUEST	
20:37	removing net from box 2 (front+center)	
20:41	this site resembles picture ANYA'S GARDEN from J.Stecher presentation during Etelsen meeting in 2004	
20:42	taking photos from mussel patch with shimmering water	
20:45	putting net back into drawer, then collecting T-logger #3 of cruise M60/3 (station 23ROV)	
20:59	replacing old Temp-logger # 3 with new Temp-logger # 11	263ROV-6
21:08	moving around close to this site	
21:23	moving to TV-grab site GTV 259	
21:35	moving OBP to site of OBT	
21:41	from trap (J.Stecher) flew 216° towards beacon #12	
21:55	positioning OBP at site near beacon #14 and OBT are	
22:12	close up on OBT, fallen over	
22:14	OBT positioned but not levelled	
22:41	trying to level OBT	
22:46	not satisfied with leveling	
22:47	end of station; diving up	

Protocol M64-2	Station: 266 ROV (Dive 58)	sample
time	Comments	#
	ROV in water, ship's position: 14°45,06 'N, 44°58,75 'W, depth: 3038 m	
12:20	reaching 2000m	
	bottom sight, 14°45,16'N, 44°58,72'W, depth: 3016+3.1m	
12:58	Video Pegasus = B, DSPL = A	
13:26	at 'Anya' marker, setting ROV position	
13:31	at IRINA-II, northern slope, view towards course 205°, depth 3032.5 m, height above ground 3.9	
13:34	heading 232°, fish	
13:38	small chimney and markers	
13:40	course 354 --> 48, musselbed experiment in front, beacon # 13	
13:41	view towards course 72	
13:49	course 98	
13:50	chimney in front	
13:52	view towards course 51	
13:59	view 53°, very large fish with wounded dorsal fin , chimney	
14:08	heading 294	
14:13	heading 268	
14:15	heading 169, near musselbed experiment	
14:20	back at chimney	
14:25	placing profiler, view 50 °, adjacent to T logger # 4	
14:33	profiler laid on its side	
14:36		
	repositioning T-Logger #4 few meters towards 80°E from mussel field position so that profiler can be placed; T-Logger layed on ground outside of mussel field	
14:41	back to profiler	
14:44	zoomed in on sensors; sensors look ok assumed they are still functioning	
14:49	positioning profiler upright	
14:51	Orion holding profiler ca. 20cm over ground for 20 minutes (moving slightly) - measurement #1 of transect. 3033.6 m water depth	266 ROV-1
15:05	zooming in on mussel field: shrimps, mussels, schlangensterne	
15:12	profiler lifted and placed to another location within the same musselbed, ROV not moved; 20 min measurement #2 of transect	266 ROV-2
15:32	profiler lifted and placed to another location within the same musselbed, ROV not moved; 20 min measurement #3 of transect	266 ROV-3
15:42	shrimps, schlangensterne	
15:52	profiler lifted and placed to another location within the same musselbed, close to logger #4, ROV not moved; 20 min measurement #4 of transect	266 ROV-4
16:32		
	leaving the site moving ROV, new measurement location close to small chimney	
16:42	starting measurement with profiler, will continue until recovery shortly before dive end	266 ROV-5
16:48	leaving the site moving ROV, going to logger #4, transect position #4, for diffuse fluid sampling	
17:01	fluid sampling through valve #4 (open valve #3 closed), pump on, nozzle tip approx. 10 cm below musselbed surface	266 ROV-6
17:05	nozzle moved, pump current 0.8 A	
17:14	moving nozzle	
17:17	moving nozzle	
17:02	pump off, valve #4 closed	
18:13	sampled musselbed with net	266 ROV-7
18:24	temperature logger # 4144 recovered	
18:30	reset at beacon #13, flying to beacon #11	
18:32	distance beacon #13 to #11: 40 m, heading 300°	
18:35	arrival at beacon #11, prepare to transfer beacon to site of beacon #13	
18:37	distance beacon #11 to #13: 34 m, heading 120°	
18:43	take off with beacon #11 for flight to beacon #13	
18:46	reset at beacon #13	
18:47	flight to Site "B" course 120	
18:51	cable on seafloor	
18:54	following cable 120°	
18:55	track on seafloor	
18:55	cable on seafloor	

19:02	course 270 °, then course 120 °, now course 157 °	
19:03	old equipment on seafloor	
19:04	growth disk with bacterial filaments; IRINA-I site M60/3- 66 ROV	
19:08	distance to beacon #13: 224m, 315°; "new" position of IRINA-1 is 60m in direction 60° from old position in scetch map	
19:13	flying 53m course 328	
19:18	arriving at site B	
19:28	2981m depth	
19:34	moving around at site "B"	
19:43	ROV takes the svenonator for temperature measurement at smoker used for sample 257ROV-7	
19:47	temperature measurement with svenonator	
19:49	temperature measurement with svenonator for 10 min at chimney 1 (left); T=350°C	266 ROV-8
20:07	temperature measurement with svenonator for 10 min at chimney 2 (right) facing NW; T=300°C	266 ROV-9
20:20	opening handle # 1	
20:24	placing nozzle into smoker	
20:30	pump on	266 ROV-10
20:33	crab, 5cm	
20:35	about 30 shrimps on pumped smoker	
20:36	ROV orientation during pumping from both smokers 308°, left smoker is in WSW and right smoker in NNE direction with respect to this rov view, water depth 2979.1m	
20:53	knocked top of chimney off	
21:08	pump off	
21:12	closing handle # 1	
21:12	opening handle # 2	
21:23	not possible to reach chimney structure to sample on filter; aborting	
21:44	taking Haralds particle catcher	
21:47	catching particles from smoker	266 ROV-11
21:53	stop catching particles	
21:56	dropping catcher in box	
22:04	going to beacon #13	
22:15	arrived at beacon #13 to collect profiler	
22:34	collecting profiler	
23:03	profiler on ROV	
23:03	start diving up	

Protocol M64-2	***Station: 272 ROV (Dive 59)***	***sample***
time	***Comments***	***#***
14:15	ROV in water, ship's position: 14°45,18 'N, 44°58,65 'W, depth: 3009 m	
16:13	bottom sight, ROV depth: 2985+7.5m, ship's position: 14°45,11'N, 44°58,65'W	
16:14	NW of Site B, beacon #11 in sight	
16:16	heading 257°	
16:19	Bottom Water Temperature Mooring (BWTM) in sight straight ahead	
16:24	position to beacon #11: 82m, heading 35°	
16:28	grabing rope at BWTM with Rigmaster	
16:29	BWTM off the ground, heading 66°	
16:31	first move to beacon #11, from there directly to IRINA I	
16:33	at Site B, now heading 120° for 55m	
16:55	moving around, searching for spot	
16:56	smoking crater in the back, plastic marker in front near bacterial mat	
16:59	deploying BWTM near mussel field between IRINA I and ANNA LOUISE, another plastic marker close by	272ROV-1
17:00	deploying beacon #15 at BWTM	
17:03	ROV cable (?) very close to BWTM	
17:09	leaving positioned BWTM	
17:09	position to beacon #11: 60m, heading 340°, water depth at BWTM: 2958m	
17:16	end of this station, moving to beacon #11, collecting this beacon and continue to beacon #14 in order to work on OBT	
17:20	beacon #11 in sight	
17:40	collecting beacon #11	
18:04	beacon #14 and OBT in sight	
18:09	beacon #11 placed on the ground	
18:14	picking up beacon #14 and placing it some distance away from OBT	
18:19	picking up OBT	
18:37	levelling OBT; very foggy	
18:41	repositioned OBT slightly SSW	
18:45	repositioned OBT slightly SSW	
18:59	trying yet another spot	
19:09	OBT positioned and leveled	
19:18	going to mussel cemetery	
19:23	collecting mussle net #8 (**244 ROV-9**)	
19:29	beacon #11 collected	
19:34	to beacon #13 77m 134°	
19:39	approachig IRINA II	
20:04	closing Niskin No 1 (right) at the west side of smoker-complex	272ROV-2
20:04	closing Niskin No 2 (middle) at the west side of smoker-complex	272ROV-3
20:04	closing Niskin No 3 (left) at the West side of smoker-complex	272ROV-4
20:12	placing Pushcore No. 2 on shimmering water coverd by mussels	272ROV-5
20:21	placing Pushcore No. 1 on shimmering water slightly covered by mussels more sediments, 50cm left of pushcore No2	272ROV-6
20:24	collecting Temp-Logger #4 from M60/3 (station 38ROV), not covered by any mussels, although it was placed directly in the vicinty of mussels	
20:38	leaving beacon # 11 back, going round of the smoker complex, approaching it from the E for mapping its west-side	
20:47	positioning for photos and than video mosaicing	
21:00	photomosaicing (5m high, 3m sideways)	
21:04	video tapes at end start all over again	
21:05	photomosaiking (4m high, 1m sideways)	
21:11	going from the eastside to the north for photomosaicing/overview	
21:14	…and back from were they have started	
21:17	end of photomosaicing	
21:33	collecting shrimps with net #8 at the E-Site of smoker complex (heading W) wihin a gap of the smoker complex, between by mussels unsettled tower and the dome structure settled with mussels at north site of the smoker complex ("shrimps	272ROV-7
21:37	Fish, Bythitidae	
21:39	taking beacon #11, end of working in IRINA II	
21:40	going for 100m N, searching an old inactive chimney	
21:43	flying above sediments	
21:44	crossing ultramafic structures, changing with sediments	
21:51	going W, into the direction of 258 GTV were we found vsicomyid shells	
21:52	outcorp, massivsulfid colored sediments 3047+0,7m	
21:54	direction to beacon #14, fish, Bythitidae	
21:56	trying to get a sample by Orion, unsuccessfully attempt	
22:06	taking a GEO-sample at the inactive smoker with net at the bottom of the inactive smoker, putting into box No 1. heading N, S-Side of smoker was sampled	272ROV-8
22:08	diving up, position Meteor: 14°45,25N, 44°58,72W, HS 3055m	

Protocol M64-2	***Station: 277ROV (Dive 60)***	***sample***
time	***Comments***	***#***
11:10	ROV in water, ship's position: 14°45,19'N, 44°58,74'W, 3049 m depth	
12:19	2000 m reached	
12:59	bottom sight, ship's position: 14°45,19'N, 44°58,75'W, 3043+6 m ROV depth	
13:03	move to IRINA II	
13:04	fish: Ophidiiformis	
13:06	mussel patch with six fishes: Bythitidae	
13:07	arriving at IRINA II, beacon #14	
13:19	deploying profiler at SW position of IRINA II above shimmering water, not far from Mirjam's pushcore experiments	277ROV-1
13:40	deployment finished, taking photos	
13:49	deploying Jens' fishing gear at the SE corner of IRINA II, next to two fishes	
14:08	taking a sonar image of IRINA II	
14:22	waiting for ship, then doing another photomosaic	
14:39	picking up fishing gear to place it closer to the main structure (up onto the mussle field)	
14:43	first try to catch the vent fish which seems to be dead	
14:45	catching the vent fish with the mussel net (fish is not dead)	
14:47	placing the mussel net with the fish in Box5; fish lost during ascent	
14:51	taking a sulphide sample with Orion to put it also in box 5	277ROV -2
15:02	flying around the the main structure	
15:10	moving the fishing gear away from the diffuse fluid region	
15:20	placing the fishing gear eastwards	
15:32	preparing the fluid sample	
15:35	open valve# 2 to pump through mirjams filter	
15:37	dspl-camera is damaged and can`t be moved	
15:50	starting to pump in a diffuse venting mussel field in between the gap of the northern and the following mussel-dome source is only be settled by shrimps	277ROV -3
16:00	on the basis of the left mussel dome, is an uncovered black area, surrounded by shrimps reflctions of particles were seen, may be sulfide or anhydrite particles	
16:10	Pump current 0.7, 26 VDC (=100%)	
16:27	Pump off during pull out, back again and pump on	
16:37	Pump off	
16:38	ROV backwards, valve #2 closed, handle #1 open (3 bottles, Rack B)	
16:47	pump on	277 ROV -4
16:50	pump off	
16:51	pump on	
17:28	fluid sampling is in ROV hovering mode; ROV position is quite stable; "fumes" from small vent a few meters below drift across the sampling point	
17:35	pump off, valve #1 closed	
17:38	open valve #4 (5 bottles)	
17:43	pump on; taking fluid sample from the smal vent at the bottem (crowded with shrimps)	277 ROV -5
17:47	at the top of the structure is a mineral complex (maybe composed of anhydrid???)	
18:02	again view on the mineral-like complex at the very top	
18:05	taking two sonar pictures; one with 5m resolution and the other with 2.5m resolution	
18:07	view on something biological (maybe snails) also at the top of the structure	
18:44	fluid sampling from a small black smoker inside the east side of a larger structure with a lot of mussels, shrimps and other beasts	
18:47	pump off	
18:50	closing handle #4 of KIPS	
18:56	handle #4 closed	
19:09	taking detail photos from east, north and west side of smoker structure (the two mussels-domes in the north of the smoker complex)	
19:24	distance measurements at the structure with laser pointer: diameter of tower like part on the north west corner is about 20cm	
19:32	taking a mussel net of mussel from the second mussel-dome from north at the basis of ist east side , nearby the fluid-sampling-station 277ROV-5	277 ROV -6
19:48	still on sampling site	
19:59	ready	

	moving to the east side of the IRINA-II smoker complex to find a position for photo
20:03	mosaicing
20:06	replacing beacon #13 about 3 meters to south east
20:16	start of photo mosaicing
20:40	flying E over sediments with ultramafic structures
20:41	going up a slope 3022m+2,5m
20:42	arriving the top of the slope 3019m+2,2m, going further E, only sediments
20:48	going up a slope 3012m+2.2m
20:50	flying east over sediments with ultramafic structures
20:51	reaching the top of the slope 3010m+2.1m
20:54	reset , distance from start 200m east
20:55	flying further up the slope 3002m+2.2m
20:58	distance from start 250m east, now flying 75m south, water depth 3003m
21:00	going up a slope 2979m+2.2m
21:01	arriving 75m south, going back to IRINA II
21:02	distance to beacon #15 at temperature mooring 190m
21:05	distance to beacon #13 265m in 280°
21:09	going west down slope, 3000m + 2.1m, over sediments
21:18	195m west from last point, coloured sediment
21:22	back at IRINA II
21:23	replacing Jen's fishing box closer to the vent structure
21:28	because of steep slopes problems by replacing the fishing box
21:34	fish
21:37	profiler collected
21:42	tape 10 for photo mosaicing
21:45	start of photo mosaicing
21:49	stop of photo mosaicing
21:55	end of dive, returning to surface

Protocol M64-2	***Station: 281 ROV (Dive 61)***	***sample***
time	***Comments***	***#***
8:30	ROV in water, ship's position: 14°45,17'N, 44°58,97'W, 3028 m depth	
13:35	bottem sight; ship`s position: 14°45,19'N, 44°58,73'W, 3045 m depth	
13:44	arriving IRINA II; searching for a position to place the benthic chamber	
14:09	placing benthic chamber at IRINA II close to beacon #13	281 ROV-1
14:14	going to site QUEST	
14:23	arriving at QUEST and viewing mussel bed	
14:25	arriving at beacon #12	
14:27	moving around	
14:28	possibly small landslide or something similar	
14:33	rocks and hollows	
14:34	steep slopes and rocks with sediment cover	
14:35	white mat	
14:52	again mussel bed with diffuse venting near beacon #12, 3049.6m	
14:54	preparing diffuse fluid sampling	
14:56	open valve #1 (rack B, 5 bottles)	
15:17	pump on	281ROV-2
15:20	six crabs and about 20 shrimps at the place of recovered temperature logger # 3	
15:25	a crab is interested in the nozzel of the pumping system	
16:16	pump stop	
16:21	handle #1 closed	
16:28	taking a mussel net from the former place of temperatur logger # 3	
16:35	sample fall out and is now lying on the porch in front of the box	
16:36	taking another sample from the same place, a piece of mussel cake, sample is in the net	281ROV-3
16:41	going to the other side of the mussel bed to deploy temperatur loggers	
16:43	placing the mussel net on the sea floor that the mussels can relax for a moment	
16:47	temperatur logger dance on the porch of ROV	
16:49	trying to insert t-logger # 10 in soil. soil is too hard.	
16:58	inserting the temperature loggers on other different points of mussel bed	
16:59	T-logger numbers are: 10, 12, 13, 14, 15, 16, 17, 18, 19	281ROV-4a-i
17:36	temperatur loggers installed	
17:39	loosing sample on porch	
17:40	picking up the mussel net 281ROV-3 in box 1	
17:52	moving to QUEST site, searching for black smoker	
17:53	flying over TV grab station	
17:54	mussel covered ridge	
17:54	6 black smokers in sight, in central depression, looking 221°	
18:01	nozzle from fluid sampling system broken off, opening strongly deformed, will still try to sample	
18:01	opening handle #4	
18:05	sampling small front right chimney, pump on	281ROV-5
19:05	pump off	
19:07	handle #4 closed	
19:09	opening handle# 2	
19:11	pump on, sampling for Mirjam's filter	281ROV-6
19:13	pump off	
19:15	pump on	
19:40	single mussel directly on smoker	
19:44	crab on smoker	
19:52	small mussel patch in fissure	
20:09	pump off	
20:11	handle# 2 closed	
20:15	taking a rock sample, placed in box 5	281ROV-7
20:17	particle sampling with a white net, placed in box 6	281ROV-8
20:20	probing the vent with helium pipe No. 3	281ROV-9

20:24	rov plays with helium pipe	
20:25	taking the helium sample	
20:32	helium pipe closed ship position: 14°45,22N, 44°58,81W, 3040m	
20:38	T-measurement with Svenonator	281 ROV-10
20:42	smoke comes out of the valve-side	
20:49	end of T-measurement; Tmax.= 285°C	
	placing Marker "MC" (with blue and yellow rope) at this sampling site of an aktive	
20:54	black smoker	
20:58	leaving site Quest, going to beacon #12	
21:00	moving along a small rigde or border of crater with a few mussel patches	
21:02	beacon #12 in sight	
21:08	beacon #12 picked up	
21:11	moving to the mussel field on QUEST site to check alignment of temperature loggers	
21:13	temperatur loggers in mussel field are aligned in 325°	
21:16	moving to beacon #13 in site IRINA II	
21:18	small ridge of rocks	
21:20	sediments with some rocks	
21:21	rock formations	
21:23	arriving at beacon #13	
21:27	brown "Russenmarker"	
21:30	ROV sits down in front of push core samplers	
21:32	taking push core sampler No. 2	281ROV-11
21:40	taking push core sampler No. 1	281ROV-12
21:51	picking up bentic chamber sampler	
21:57	end of dive, ascending to Meteor	
0:00	ROV on board, end of station.	

Protocol M64-2	***Station: 283 ROV (Dive 62)***	***sample***
time	***Comments***	***#***
12:20	ROV in water, ship's position: 14°45,23'N, 44°58,75'W, 3049 m depth	
14:43	reaching 2500m	
15:05	bottom sight; ship`s position: 14°45,18'N, 44°58,79'W, ROV depth: 3037,5+11,3 m	
15:05	first positioning with respect to beacon #14	
15:10	OBT in sight	
15:20	ROV is on the ground next to OBT, OBT not leveled anymore	
15:24	off the ground again, moving to QUEST site first	
16:01	mussel bed experiment in sight	
16:10	3 Niskin bottles triggered, collecting shimmering water above this mussel bed (two front ones, left one from second row)	283ROV-1
16:20	starting to place two T-loggers (8-channel) within the mussel patch started with No 295, 298	283ROV-2a, 283ROV-2b
16:35	finishing t-logger positioning, 3044m, ship at 44°58,82W, 14°45,20N	
16:41	staring photomosaicing	
16:43	removing the poarch out of the picture frame DSPL, recorder VCRB (tape: DIVE 62-B-3), heading 232°, altitute 2,2m starting at 16:45:00, Waterdepth 3043m Direction to WNW (moving from left to right)	
16:47	starting into the opposite direction, ESE	
16:49	moving back to 52°, 1,5 m down the slope, starting the sequenz parallel to mussel patch from left to right and from right to left. Stopping the record at: 16:53	
16:53	going ahead moving up the slope crossing over the musselpatch	
16:54	starting the third mosaicing from left to right and returning to complete the mosaicing	
16:56	end of photomosaicing	
16:59	going E	
17:07	approaching OBT and OBP, recovering net **244ROV-10**	
17:16	starting for new positioning of OBT	
17:51	end new positioning of OBT	
17:53	going to IRINA II	
18:07	at beacon # 13	
18:14	Irina II musselbed	
18:21	mussel net # 3 fishing vent fish. Failed.	
18:25	musselbed experiment: 8-channel logger # 297 vertical	283ROV-3a
18:34	musselbed experiment: 8-channel logger # 296 horizontal	283ROV-3b
18:42	Position of T probes:	
18:55	2m (directed to 60°) away from the basis of smoker complex and 4m away from the T -loggers No297 and No296. They are standing in SSW of the smoker comlpex	
19:05	open valve #1, resampling site 281ROV-10 at "Glitter Vent"	
19:08	placing the nozzle into the opening, pump on ; ship at 44°58,72W; 14°45,21N, 3035m	283ROV-4
19:35	pump off	
19:35	reinserting pump nozzle in vent	
19:37	pump on	
19:41	somewhat larger shrimp on top of smoker structure	
19:47	inspecting shrimps, nice video sequences of biozenosis	
19:54	and inspecting mussels	
20:03	crab eats a mussel ?	
20:06	pump off	
20:06	reinserting pump nozzle in vent	
20:10	pump on	
20:12	nozzle out of vent - reinserting	
20:21	pump off	
20:27	handle #1 closed	
20:32	handle #2 open, pump on with Mirjams filter from smoker	283ROV-5
20:46	photo mosaic auf DSPL tape B6	
20:50	end of photomosaic	
21:16	pump off	
21:18	handle #2 closed	
21:25	shrimp sample	283ROV-6
21:37	temperature measurement with "svenonator"	

21:39	temperature measurement at diffusive fluids; Tmax.= 225°C	283ROV-7
21:41	end of measurement	
21:41	temperature measurement at black smoker	283ROV-8
21:46	end of measurement	
21:50	collecting beacon 13	
21:55	temperature measurement at smoker SSW of IRINA II smoker complex	283ROV-9
22:01	end of measurement; Tmax.= 170°C	
22:03	collecting beacon # 13	
22:12	collecting the fishing box	
22:17	moving around at smoker complex	
22:18	check for luminiscence	
22:22	ascending and end of ROV session	
0:45	ROV on deck	

Protocol M64-2	***Station: 285 ROV (Dive 63)***	***sample***
time	***Comments***	***#***
12:10	ROV in water, ship's position: 14°45,23'N, 44°58,98'W, 3034 m depth	
13:52	2777m	
14:03	bottom sight, ship's position: 14°45,24 'N, 44°58,82 'W, ROV depth: 3032	
14:22	lost CTD "bottom contact-warning weight" found on top or large boulder	
14:26	rough surface with rock outcrops, boulders	
14:29	OBT, OBP in sight, keeping large distance to the instruments	
14:31	going W 254°	
14:32	tectonized rock outcrop	
14:35	going uphill, steep slope with boulders, still 240° WSW	
14:37	QUEST musselfield experiment in sight	
14:43	heading 329°, site view picture	
15:13	try to take sample SW of mussel field and 0.5m SW of T-logger #19 with push core - failed	
15:15	push core #4 can not be removed from its socket, 8 damaged, thickness of sediments is at least 0.3m	
15:22	moving west about 1.5m	
15:26	next try with push core 3 - failed	
15:28	thickness of white layer is about 5cm	
15:29	another try with push core 3 0.3m east of the last try	
15:32	push core 3 completely filled, layering from top to bottom 2cm white, 15cm brown, 10cm white	
15:34	loosing some sediment from push core, dropped in push core socket 8 and 3	
15:38	push core sockets in rov box blocked by T-handles and ropes	
15:40	placing push core 3 on porch and removing of T-handles and ropes	
15:41	picking up push core 3 from porch	
15:44	push core 3 back in its socket	285ROV-1
15:50	niskin bottle 4 closed, right bottle in front row	285ROV-2
15:52	leaving the position	
15:55	push core sample with No. 4 about 1m NNE from mussel field at Quest site, push completely inserted and completely filled with brown sediments	285ROV-3
15:59	push core 4 back in ist socked	
16:03	niskin bottle 5 closed next to musselpatch, left bottle in front row	285ROV-4
16:34	collecting mussel net, placing in box #3, front right	285ROV-5
16:55	start mapping along a profile, first moving 150m in direction WEST (271°)	
16:57	flying across sediment, some ripples, few blocks, 3038 m depth	
16:59	sediment covered talus	
17:03	sediment, 3025 m depth	
17:06	waypoint 1, now 10 m direction NORTH (0°)	
17:10	waypoint 2, now 180 m direction EAST (91°), 3018 m	
17:11	sediment covered talus	
17:13	larger blocks in sight, followed by sediment covered talus 3028 m depth	
17:17	flying at northern rim of QUEST hydrothermal field	
17:19	sediment covered outcrop area 3056 m	
17:20	waypoint 3, now 10 m direction NORTH (1°)	
17:21	waypoint 4, now 180 m direction WEST (270°), 3056 m depth	
17:23	moving across sediment covered outcrop area again)	
17:23	sediment with ripples, few blocks	
17:25	3036 m depth	
17:25	larger boulders, 3029 m depth	
17:27	sediment covered talus, followed by rocks ridge 3020 m depth	
17:29	sediment, 3015 m depth	
17:31	sediment covered talus, 3012 m depth	
17:32	waypoint 5, now 10 m direction NORTH (1°), 3010 m depth	
17:33	waypoint 6, now 180 m direction EAST (89°), 3009 m depth	
17:35	talus and large block	
17:38	sediment covered talus	
17:41	3031 m depth	
17:42	blocky talus	

17:44	sediment with ripples
17:45	waypoint 7, now 20 m NORTH (0°), 3055 m depth
17:46	sediment covered mound
17:46	waypoint 8, now 180 m WEST (270°), 3059 m depth
17:49	sediment, 3041 m depth
17:52	larger blocks with sediment, 3020 m depth
17:54	large fractured boulder in sediment, 3013 m depth
17:57	sediment, 3010 m depth
17:57	waypoint 9, now 20 m NORTH (0°), 3011 m depth
18:02	waypoint 10, now 180 m EAST (83°), 3014 m depth, talus hill
18:06	holothuria on sediment, 3013 m depth
18:10	sediment covered talus, 3020 m depth
18:12	sediment with ripples in direction W-E, 3038 m depth
18:16	high particle flux in water, 3058 m depth
18:17	waypoint 11, "something in sonar straight ahead", moving 100 m in this direction (EAST)
18:19	sediment with ripples, 3059 m depth
18:20	rocky ridge, 3061 m depth
18:25	waypoint 12, now 20 m NORTH (0°), 3050 m depth
18:25	sediment covered talus
18:27	waypoint 13, now 265 m WEST (270°), 3050 m depth
18:31	sediment covered talus
18:33	yellow colored sediment
18:34	high particle flux in water, 3058 m depth
18:35	tracks across ripples
18:36	rocky ridge, 3048 m depth
18:37	blocky area, 3040 m depth
18:38	blocky area, 3030 m depth
18:40	few larger boulders, 3027 m deepth
18:44	sediment, 3020 m depth
18:45	talus
18:46	sediment, 3020 m depth
18:48	waypoint 14, now 20 m direction NORTH (0°), 3025 m depth (14°45,27'N, 44°58,87'W)
18:50	sediment with talus
18:51	waypoint 15, now 180 m EAST (90°), 3025 m depth
18:56	sediment, 3030 m depth
18:57	talus on ridge
19:00	sediment, 3047.5 m depth
19:03	rock outcrop, 3052 m depth
19:04	waypoint 16, now 20 m direction NORTH (0°), 3052.6 m depth (Ship:14°45,28'N, 44°58,82'W)
19:05	outcrop on top of hill, steep slope towards N
19:07	sediment covered rock
19:08	waypoint 17, now 180 m WEST (270°), 3057.5 m depth (Ship:14°45,29'N, 44°58,83'W)
19:15	sediment, 3035 m depth
19:19	rock outcrop, 3024 m depth
19:22	waypoint 18, now 25 m direction NORTH (0°), 3029 m depth (Ship:14°45,29'N, 44°58,84'W)
19:22	sediment covered rock, outcrop
19:24	waypoint 19, now 180 m EAST (90°), 3027 m depth
19:25	sediment covered rock, outcrop
19:27	TV grab mark in sediment (Ship:14°45,31'N, 44°58,84'W) M60/3-82 GTV ??
19:36	sediment, 3072.4 m
19:38	waypoint 20, now 25 m NORTH (0°), 3072.6 m depth (Ship:14°45,31'N, 44°58,84'W)
19:40	waypoint 21, now 180 m WEST (270°), 3075.3 m depth (Ship:14°45,32'N, 44°58,84'W)
19:40	sediment covered rock, outcrop
19:45	sediment, depth 3062 m

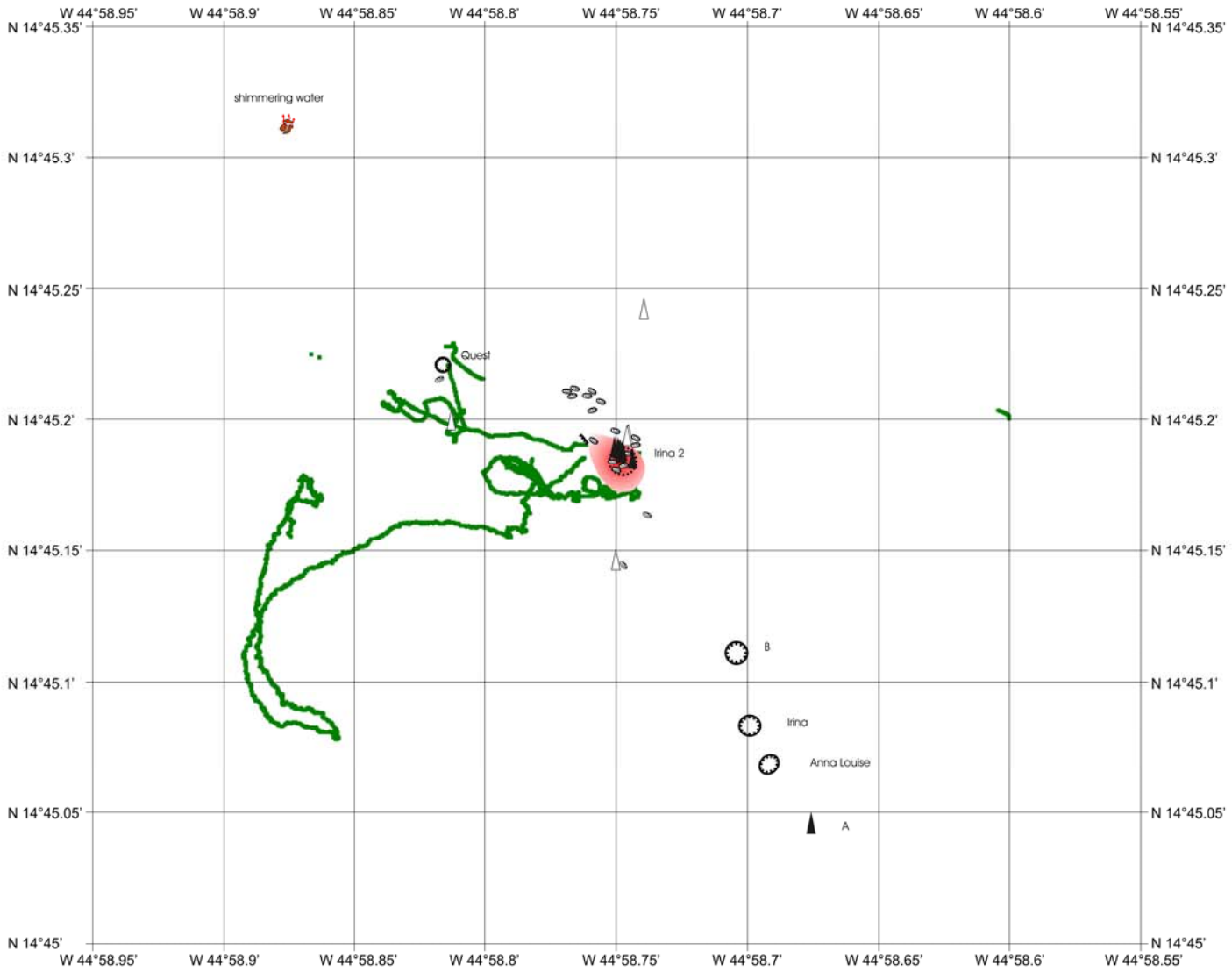
19:46	rock outcrop, 3059 m depth	
19:47	brownish-orange crusts on rock, shimmering water, orange sediment surface	
20:24	sample of orange crust taken with shovel	285ROV-6
20:35	at the northern end small former orifices, no shimmering water anymore	
20:38	continue the mapping track, due WEST to waypoint 22	
20:44	waypoint 22, now 20 m direction NORTH, 3050 m depth	
20:47	waypoint 23, now 180 m direction EAST, 3056 m depth	
20:53	sediment, some blocks, 3069 m depth	
20:57	sediment covered talus	
20:59	ridge with lots of reddish-orange crusts	
20:59	waypoint 24, now 20 m NORTH, 3078 m	
21:02	waypoint 25, now 180 m WEST, 3080 m	
21:03	red hydrothermal crusts	
21:14	waypoint 26, now 20 m NORTH, 3060 m (above old hydrothermal crusts)	
21:19	waypoint 27, now 180 m EAST, 3065 m	
21:27	sediment, few large boulders, 3080 m	
21:30	*Munidopsis*	
21:33	waypoint 28, now 20m NORTH, 3090 m	
21:37	waypoint 29, now 180 m WEST, 3090 m	
21:47	large blocks	
21:50	waypoint 30, end of station, end of M64-2 cruise program	

Appendix 10:

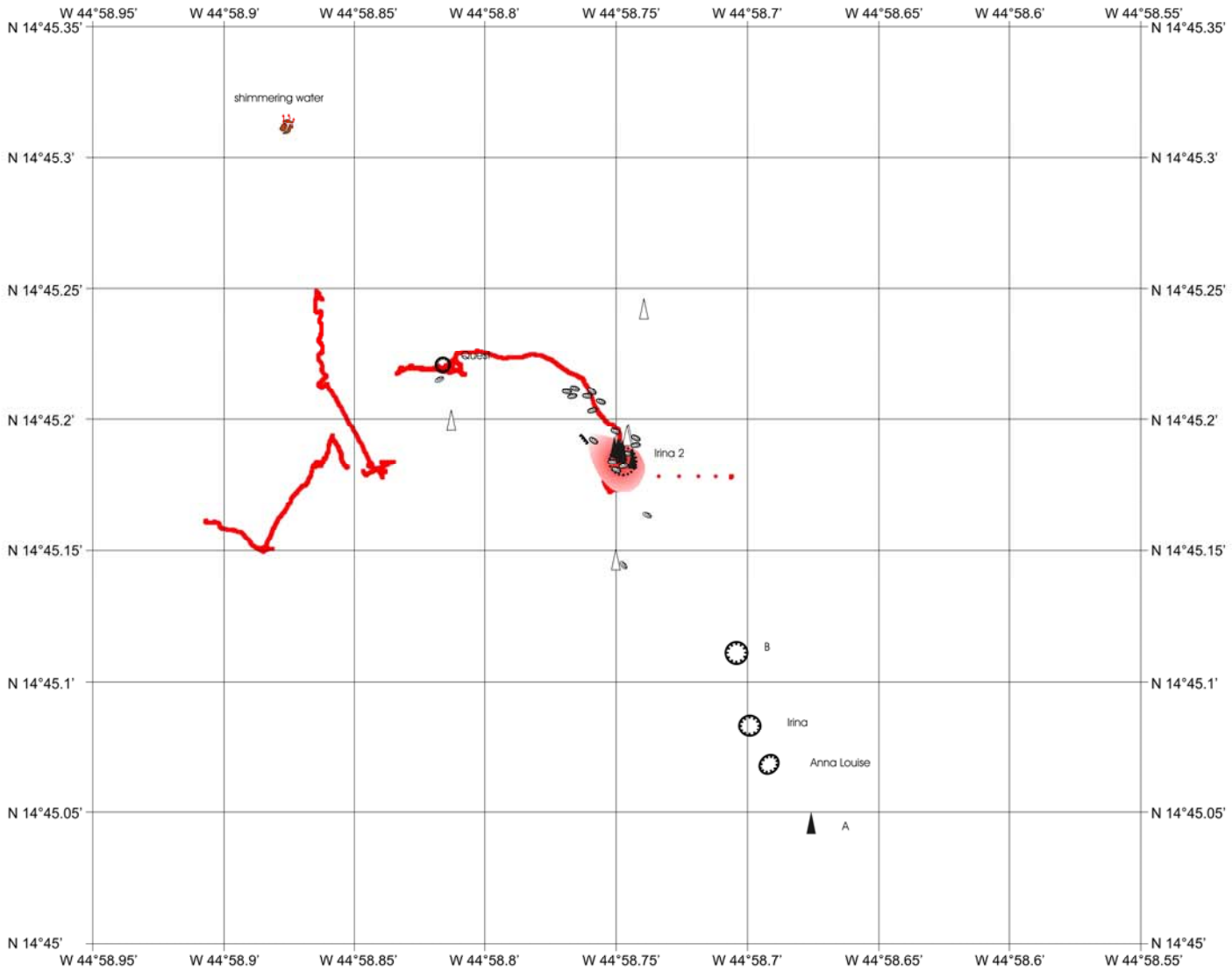
Detailed maps of ROV tracks

compiled by Kerstin Schreiber

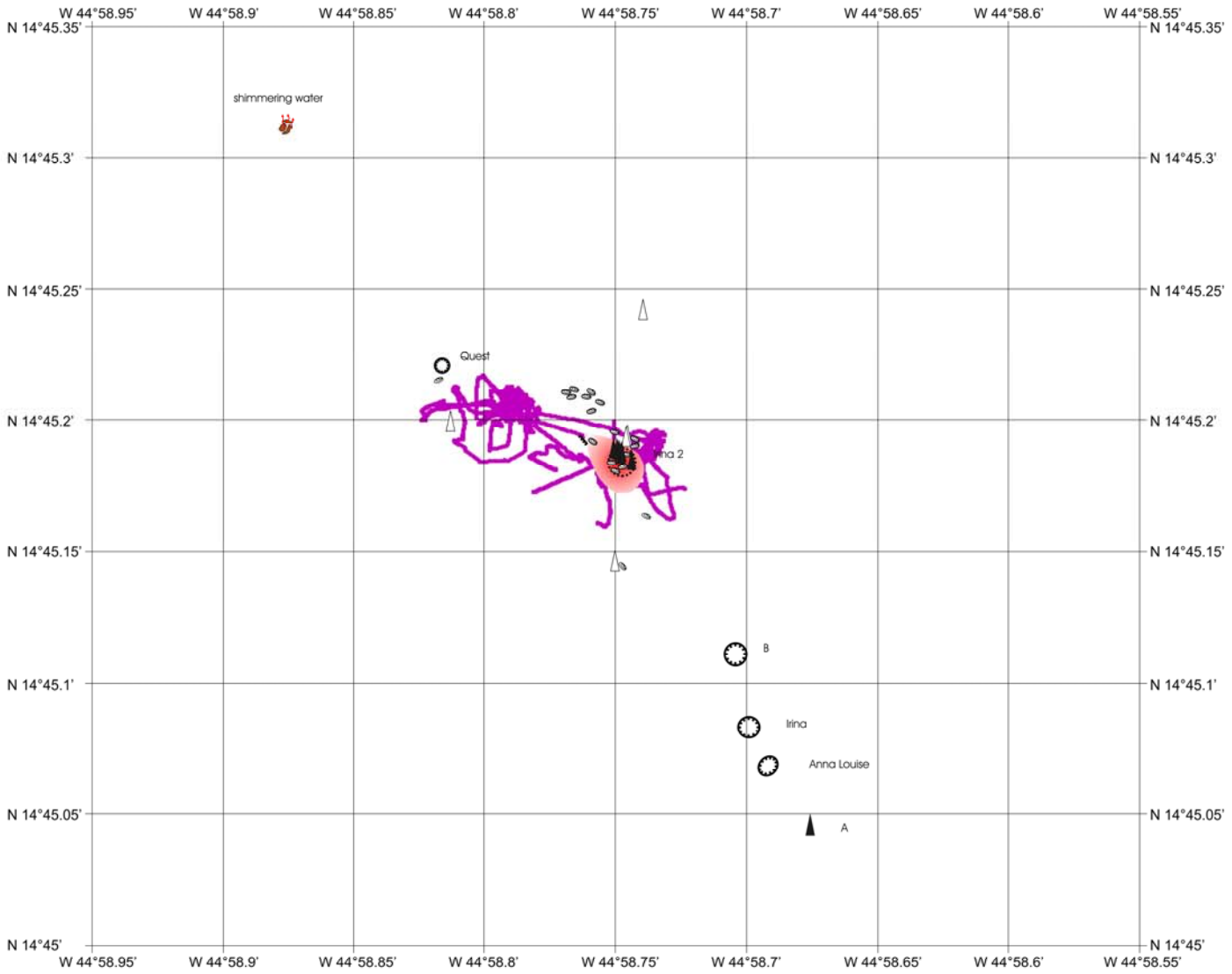
224 ROV (Dive 50B)



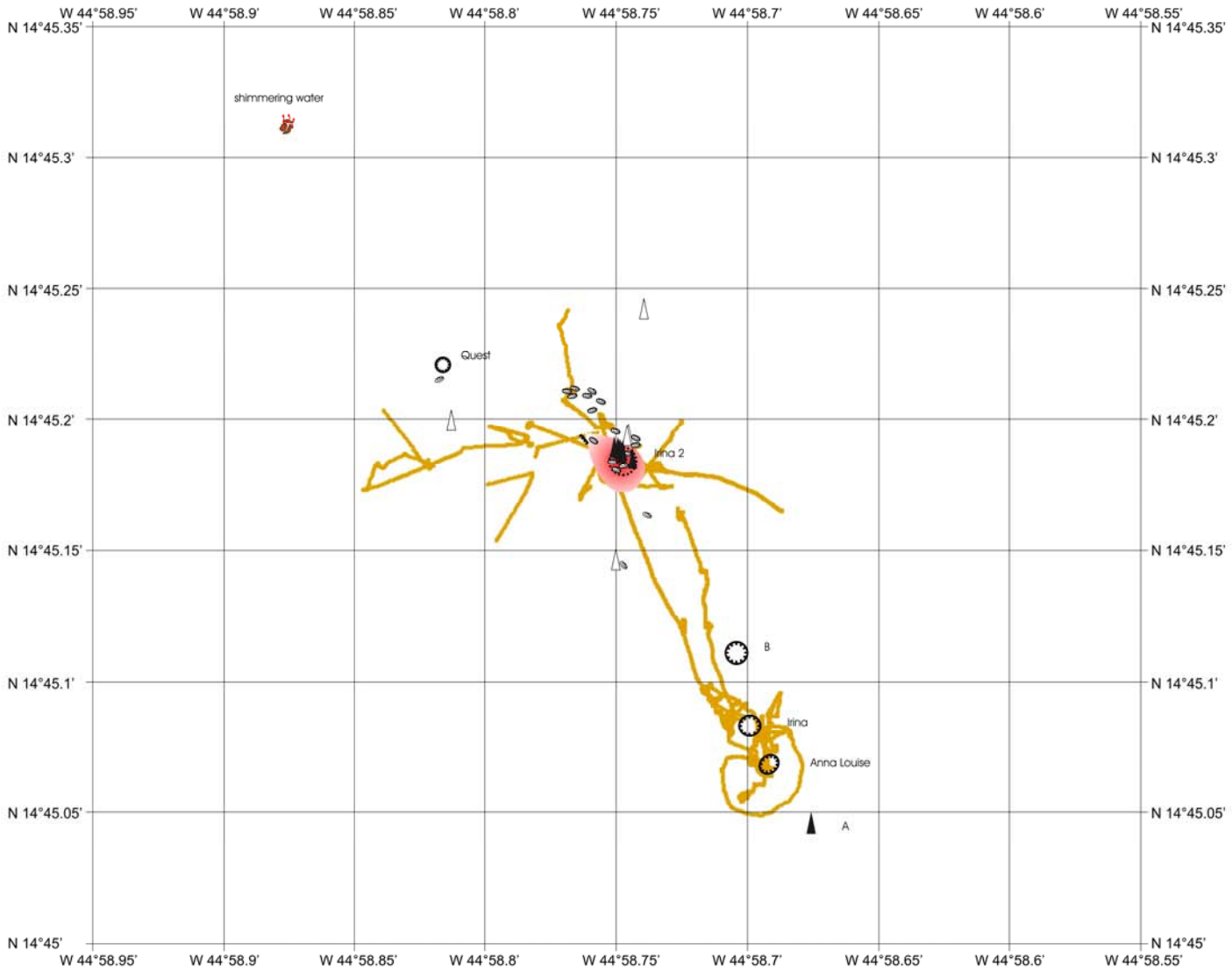
232 ROV (Dive 51)



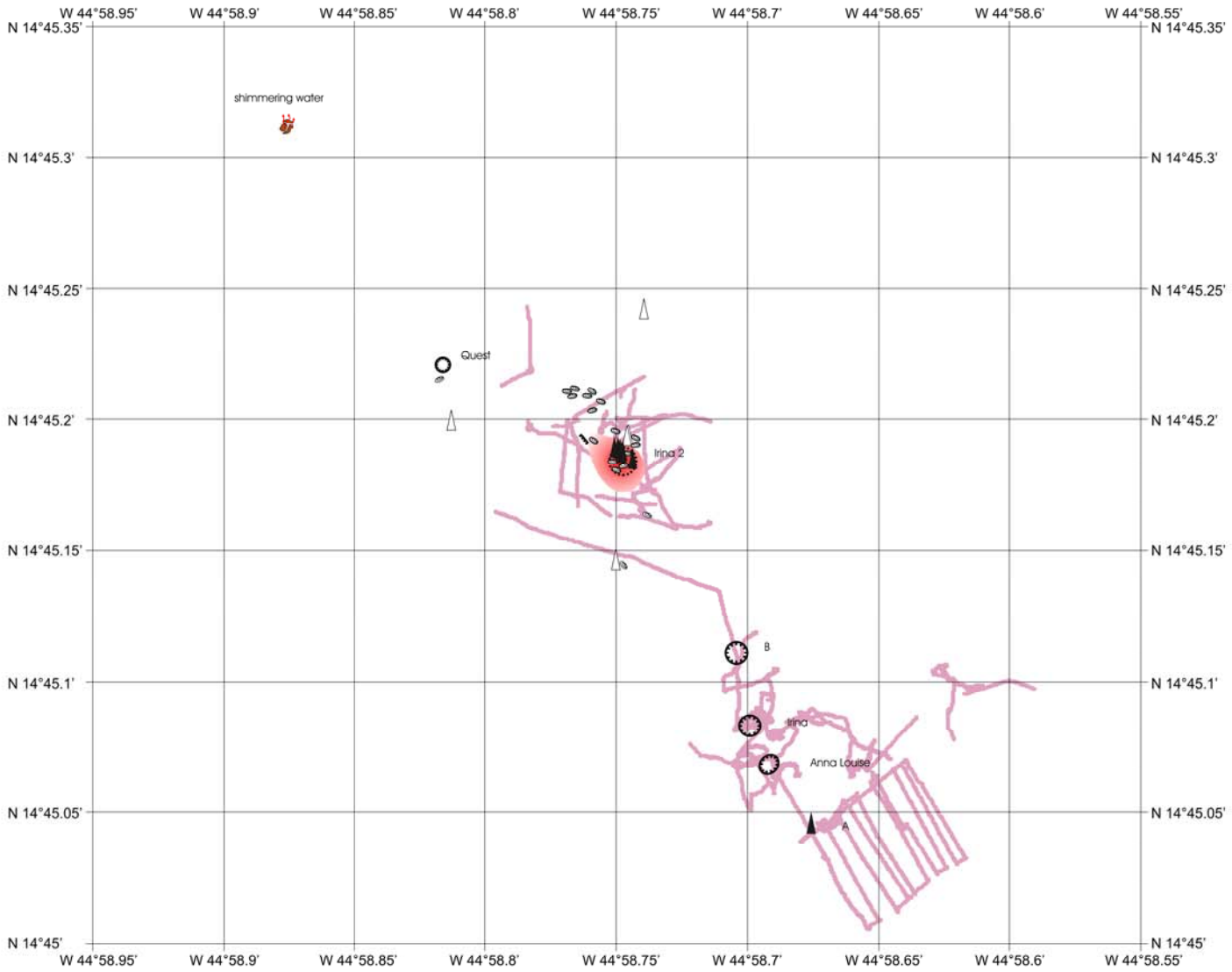
244 ROV (Dive 52)



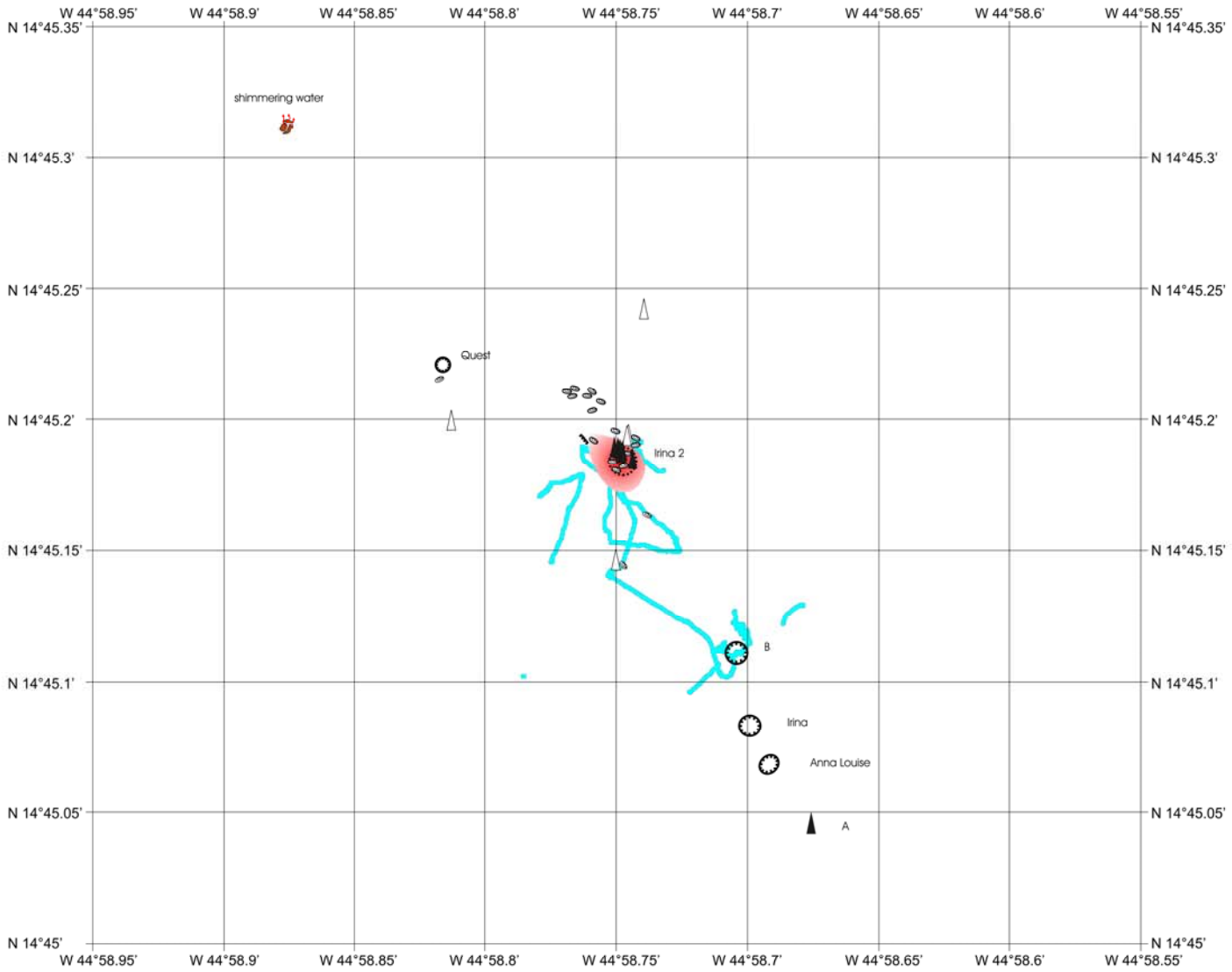
249 ROV (Dive 53)



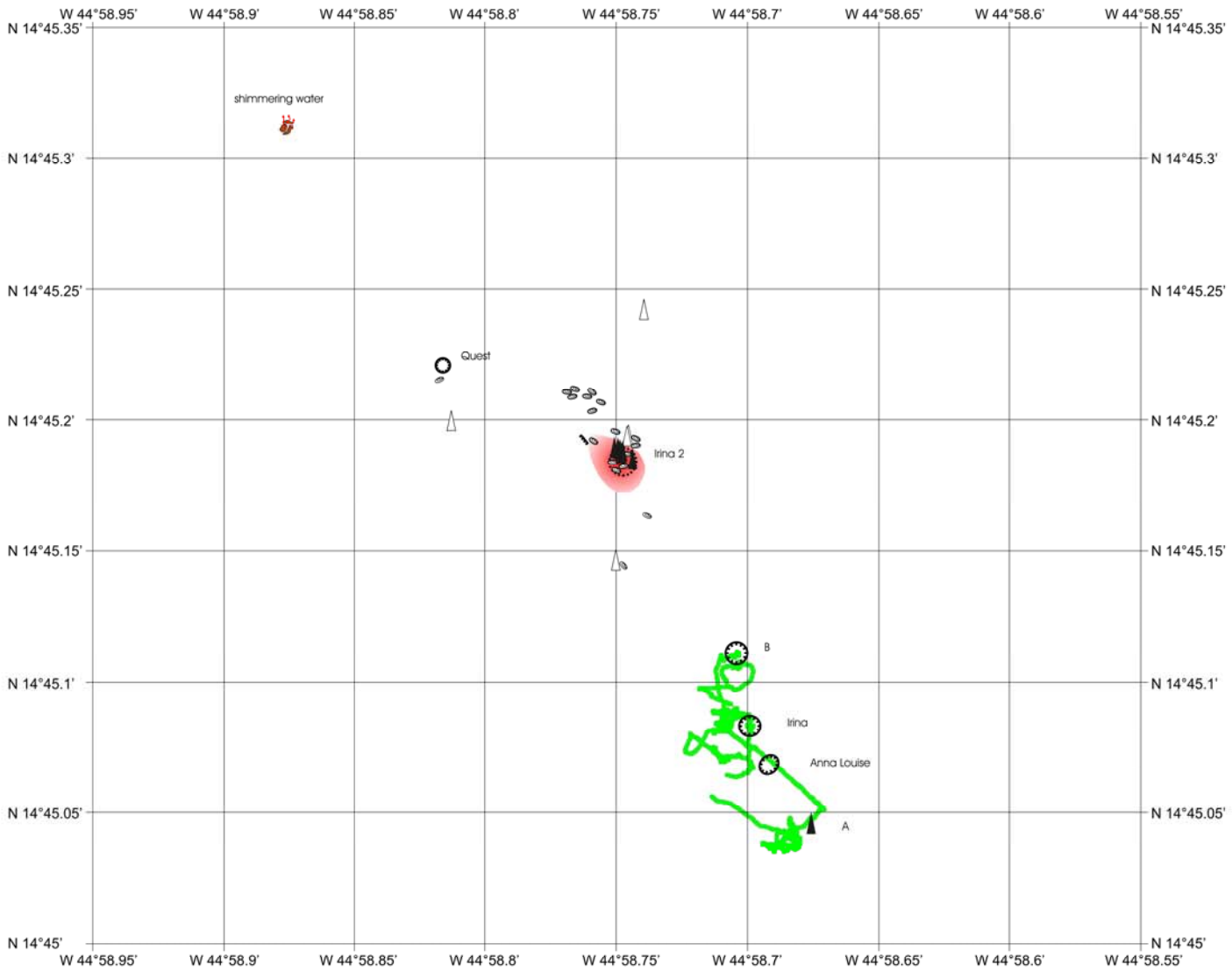
252 ROV (Dive 54)



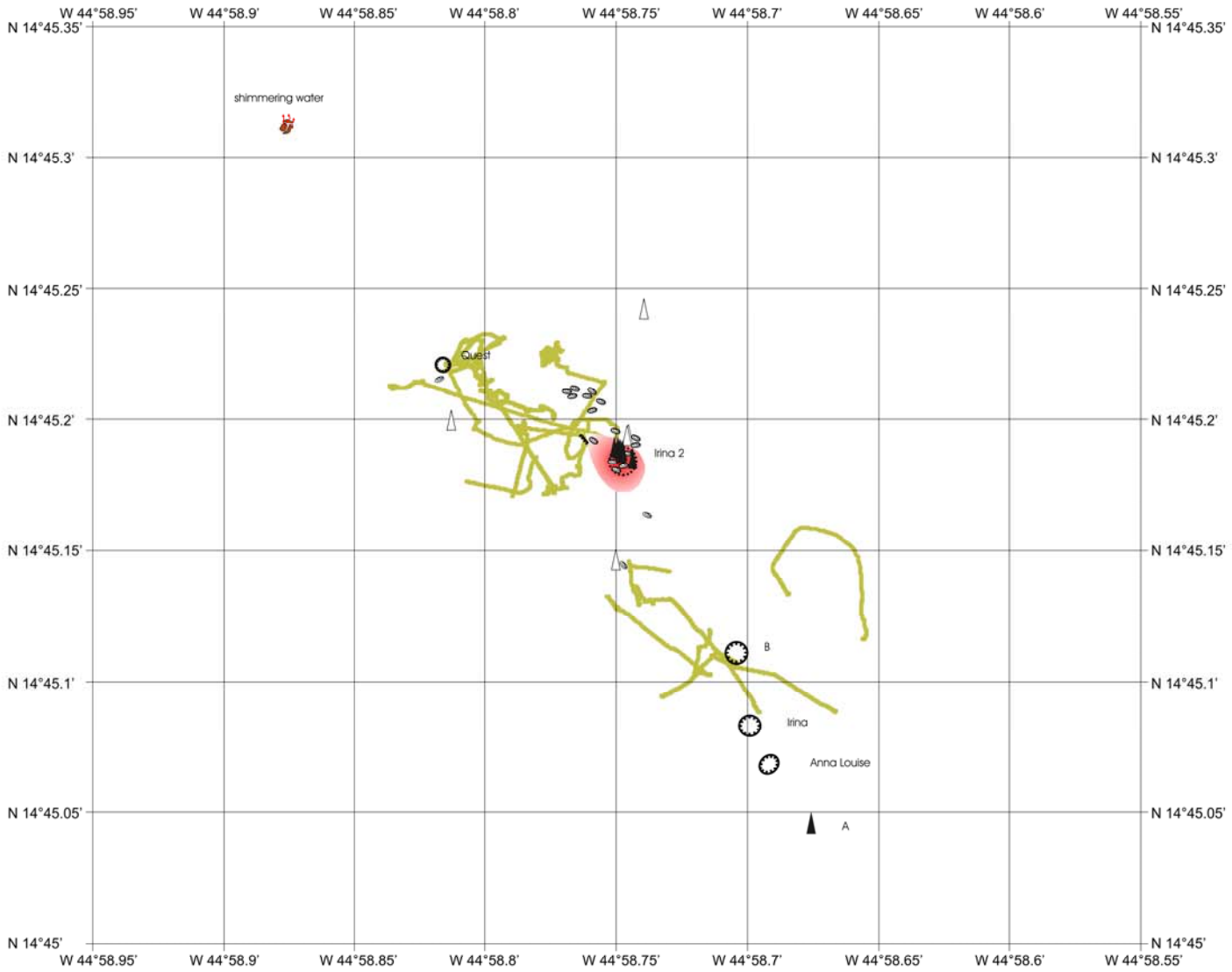
257 ROV (Dive 55)



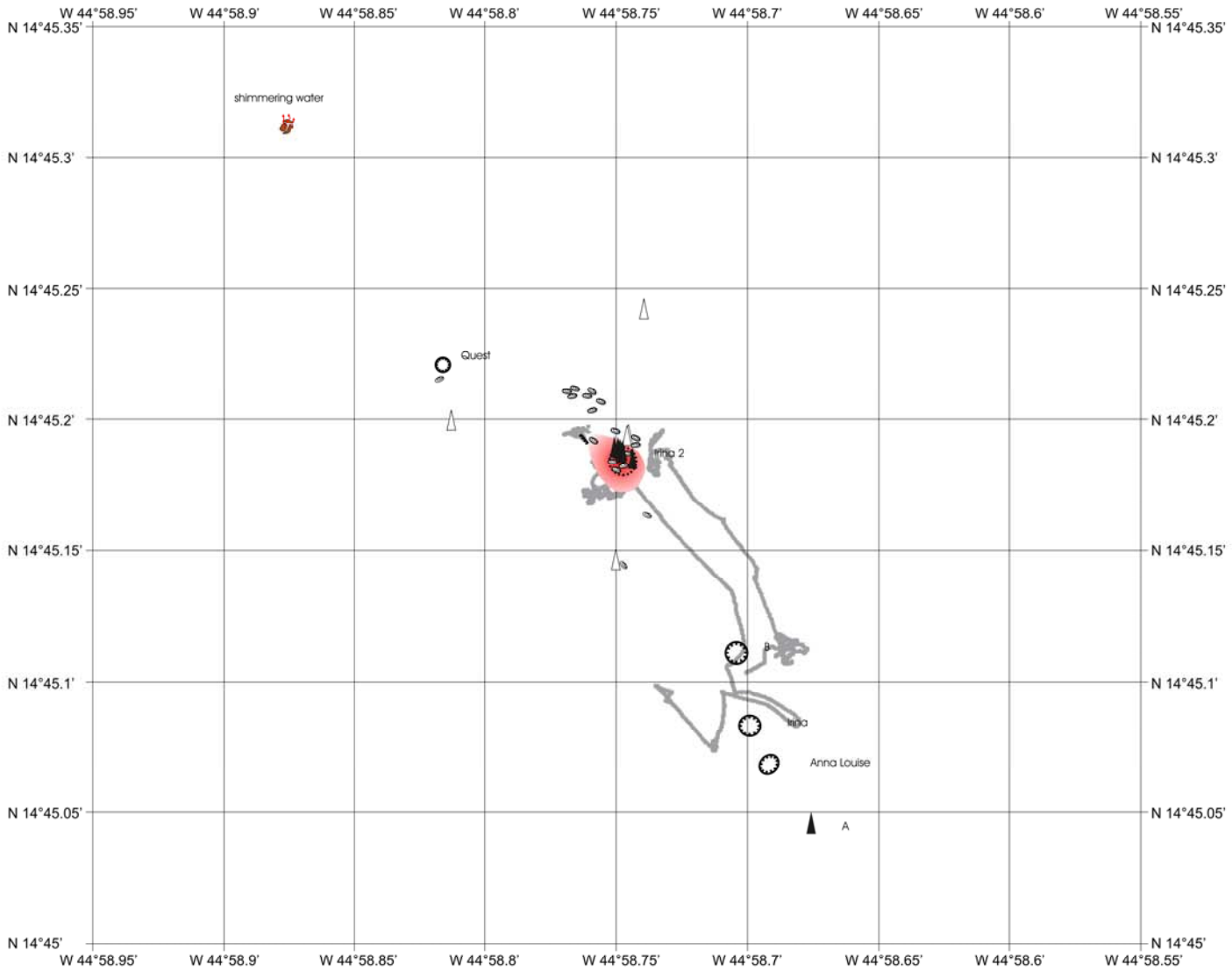
261 ROV (Dive 56)



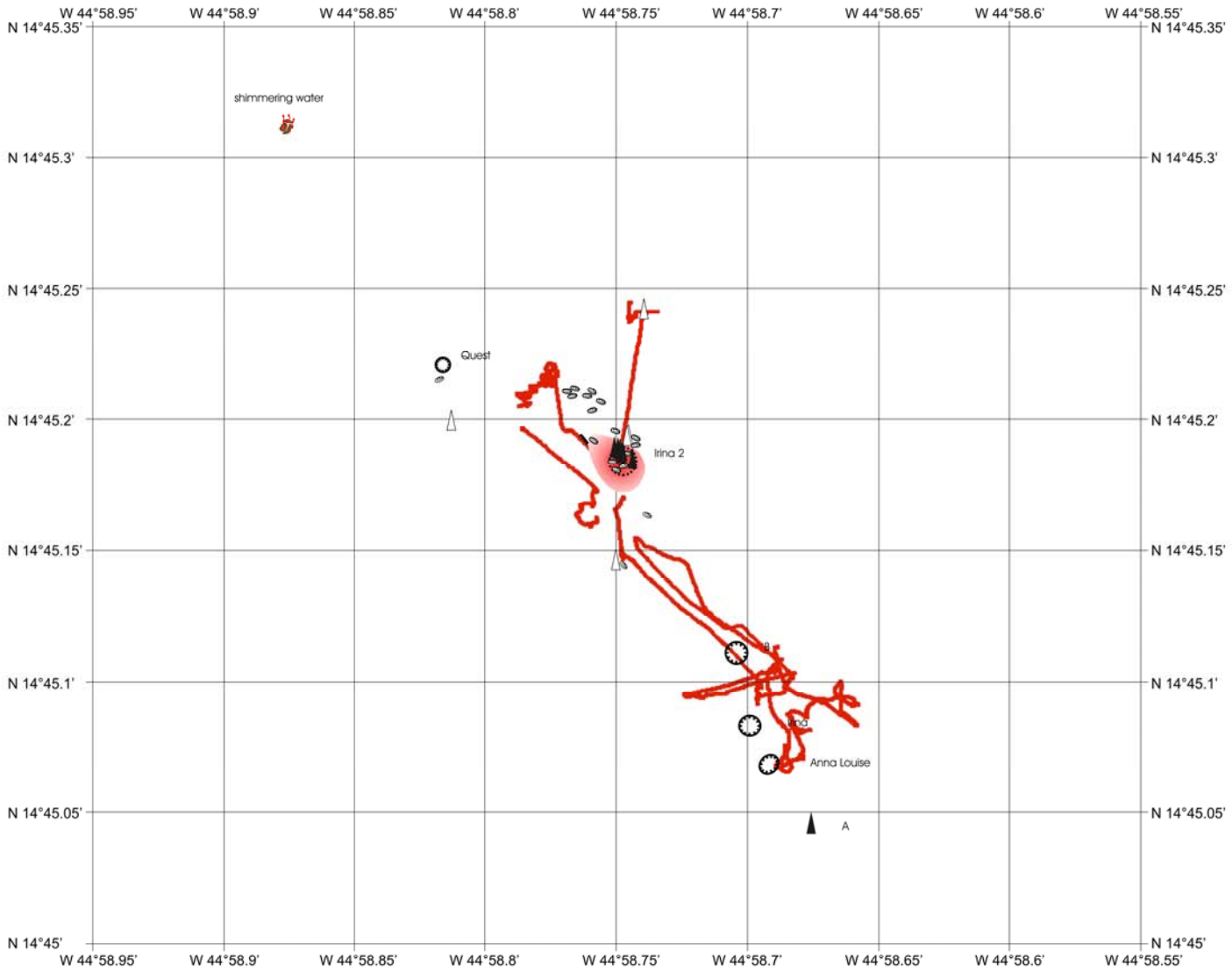
263 ROV (Dive 57)



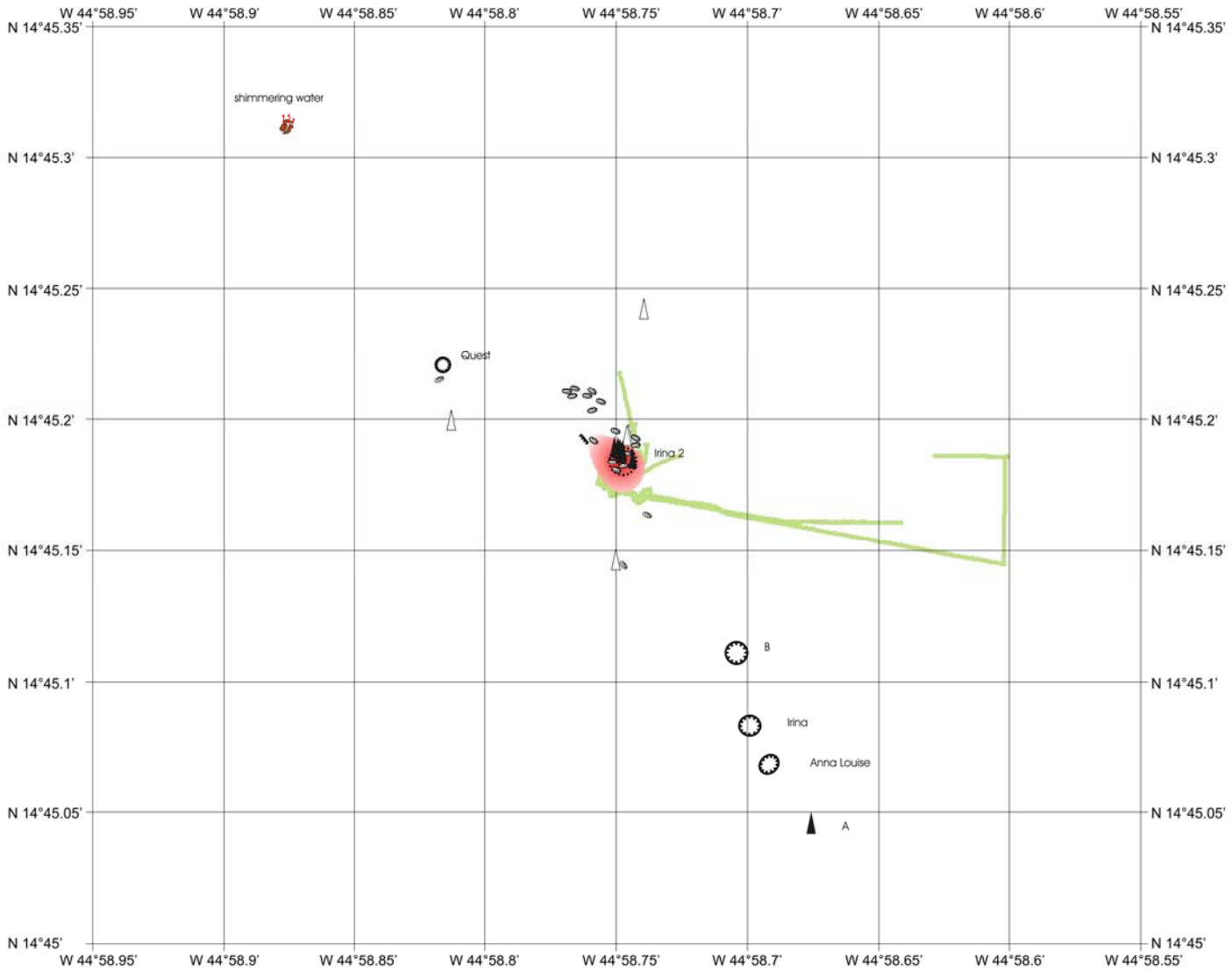
266 ROV (Dive 58)



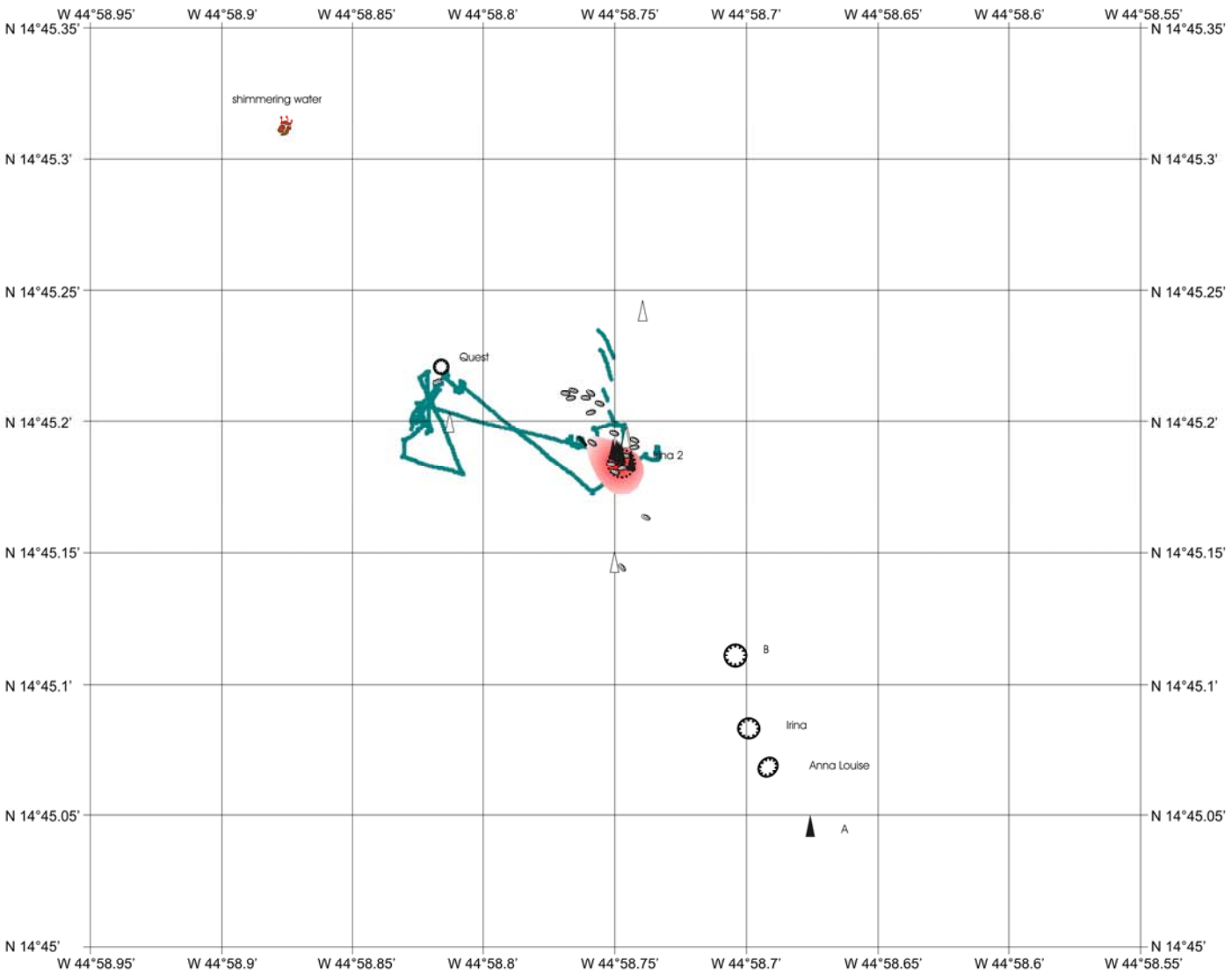
272 ROV (Dive 59)



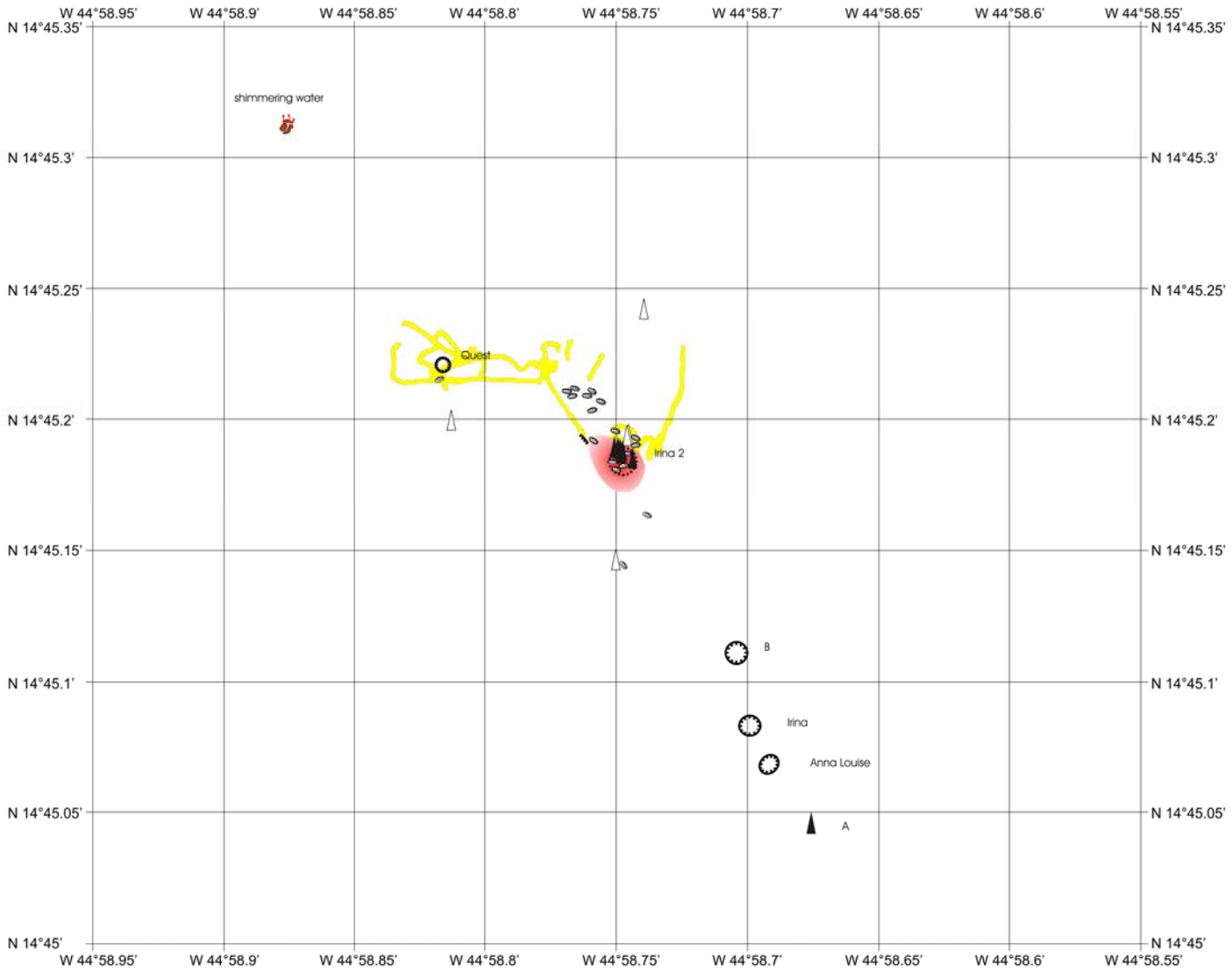
277 ROV (Dive 60)



281 ROV (Dive 61)



283 ROV (Dive 62)



285 ROV (Dive 63)