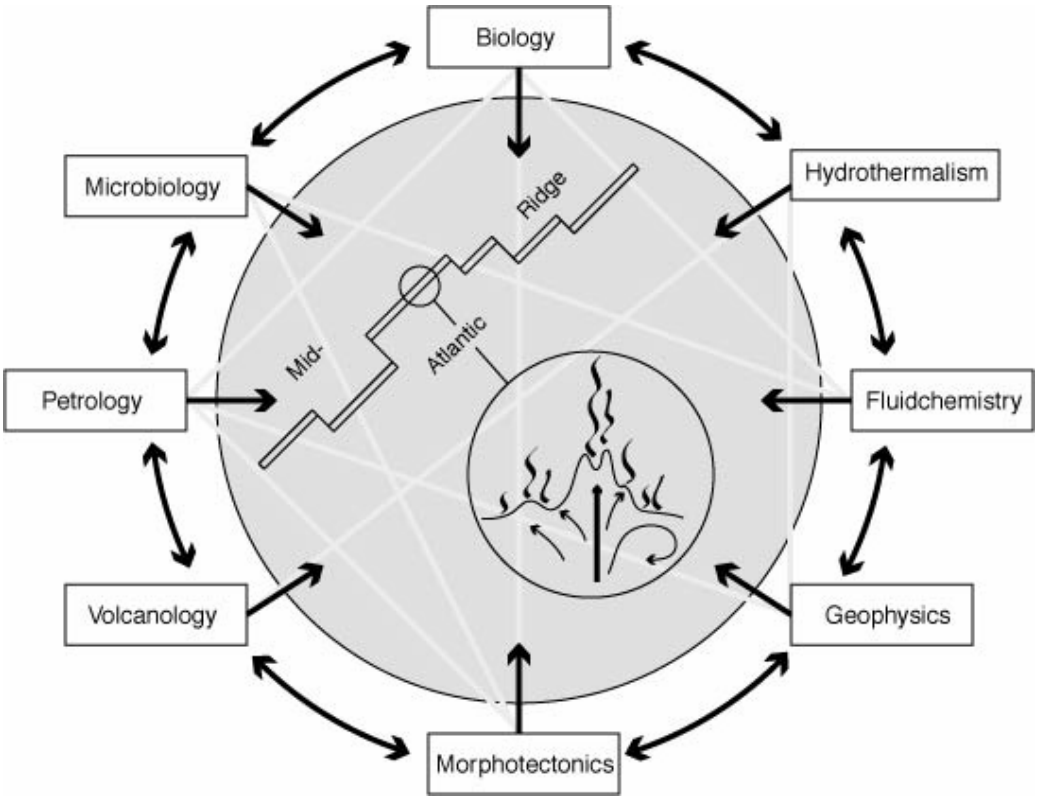
Mid-Atlantic Expedition 2009

FS METEOR Cruise No. 78, Leg 2

Mantle to ocean on the southern Mid-Atlantic Ridge (5°S - 11°S) (MAR-SÜD V)

02.04.2009 Port of Spain – 11.05.2009 Rio de Janeiro



SPP 1144: "From Mantle to Ocean: Energy, Material and Life Cycles at Spreading Axes".

Content

2.1 Participants

***Leg* M 78/2**

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2.2 Research Program

This cruise was the last scheduled within the DFG Special Priority Program 1144 to the major study site at 5° to 11°S, on the southern Mid-Atlantic Ridge (MAR), following the investigations performed during and subsequent to cruises M62/5, CD169, M64/1, M68/1, and L'Atalante II 2008. Work focused on cross-disciplinary core questions of the SPP 1144:

- How does the energy and mass transfer from the mantle into the ocean take place?
- What are the time scales on which processes at spreading axes occur?
- How does the regional geology influence and control vent fluid com-position and spatial and temporal changes in hydrothermal fluxes?

To answer these questions, a comprehensive set of data and samples was obtained from 4 hydrothermally active areas:

- Vents around 4°48´S: Found and sampled for the first time in 2004 during cruise M64/1, these vents provide a wide variety of fluid types, habitats and geological settings to investigate the linkages between magmatism, fluid circulation and ecosystems in the deep sea.
- Inside corner high at 5°S: There is mounting evidence that the deep crust also plays an important role in hydrothermal circulation and that water in the deep crust can strongly influence magmatic processes. Earlier studies during M47/2 and L'Atalante 2008 have shown the presence of good lower crustal exposures on an inside corner high just south of the 4°48´S vent fields.
- The 'Nibelungen' field hosting the 'Drachenschlund' black smoker vent found during M68/1 at 8°18′ S/13°30′W in 2915 m water depth. This is one of the few known ultramafic-hosted systems, the first of its kind to be found on the southern MAR.
- Lilliput Vent Fields at 9°32´S: Discovered during M64/1, this area located in much shallower water than the 4°48´S vents provides an ideal compliment, enabling the influence of water depth on hydrothermal and biological processes to be investigated in a systematic way for the first time.

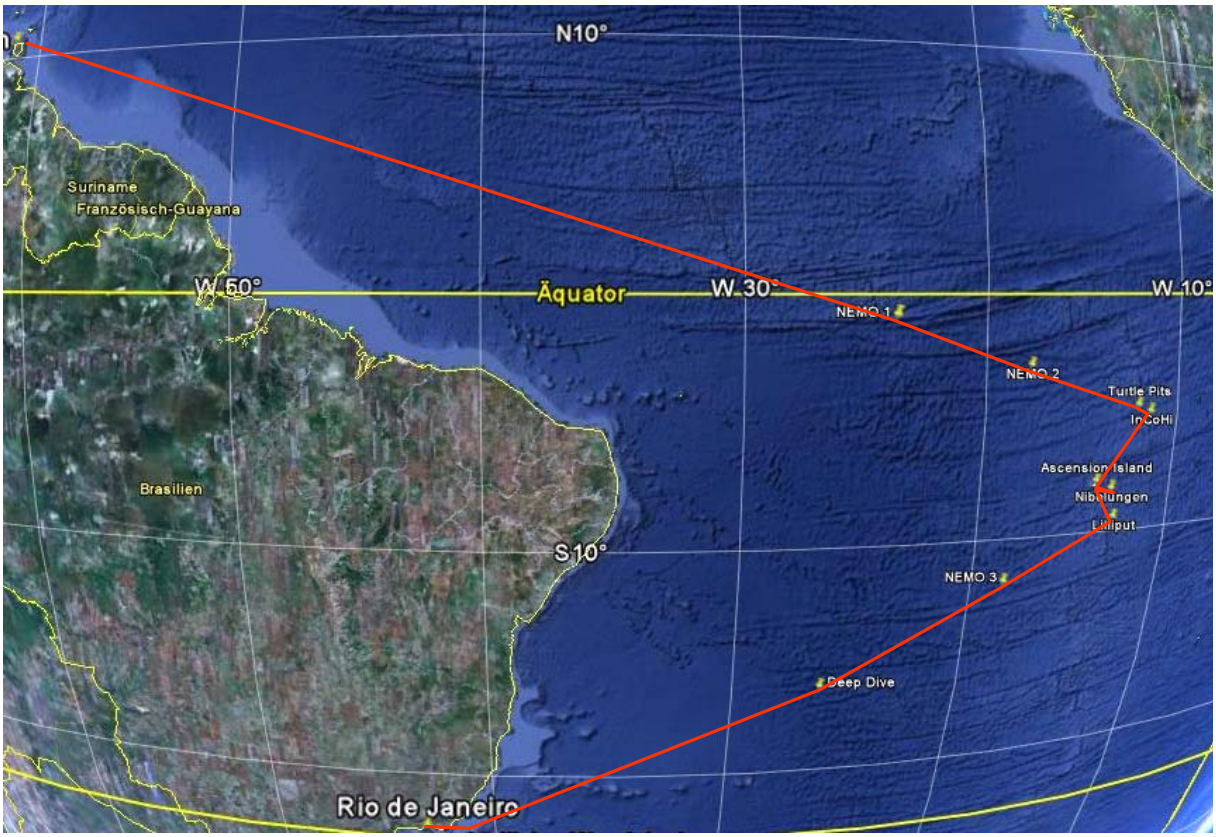
The work comprised measurements at individual vents (ROV "Kiel 6000", IFM-GEOMAR), detailed plume mapping (AUV, CTD) and integrated analysis of the flow field (CTD, moorings, AUV). The investigation of trace metals and dissolved gases (including signatures of stable isotopes) for fluids of distinct vents carried on the time series investigation started in 2005 and should contribute significantly to understand the evolution of the vent systems.

Methodologies applied to obtain data and samples were:

- A Remotely Operated Vehicle (ROV Kiel6000, IFM-GEOMAR) for ocean floor investigations and sampling of microbial mats and water samples including the application of a profiler to obtaining geochemical profiles of the upper sediment layer *in-situ*;
- an Autonomous Underwater Vehicle (AUV Abyss, IFM-GEOMAR) for plume mapping and high resolution bathymetry;

- CTD/Carousel water sampler equipped with ADCP and Back Scatter Sensor for profiling and sampling of the water column;
- Wax corer (VSR) for sampling basaltic glasses;
- Multi Beam Echo-Sounding (EM 120) surveys for bathymetry.

In total, 87 stations were performed within the 17.5 working days including 16 ROV-dives, 23 sediment stations (VSR), 22 water stations (CTD), and about 1000nm of profiling (multi beam echo sounding).



Track of R/V METEOR cruise M78/2 (satellite map: Google Earth)

2.3 Narrative M78/2

(Richard Seifert)

01. to 14.04.
FS Meteor left Port of Spain, the Capital of Trinidad And Tobago, with a delay of one day against schedule, April 2nd at noon aiming to the active hydrothermal areas located at 04°48'S, 012°22'W on the Mid Atlantic Ridge (MAR). This delay was caused by a belated arrival of the team responsible for the mobilization of the ROV Kiel6000 and the AUV Abyss, planned to start at March 28th. The transatlantic flights missed to be in time for the connecting flights from Bridgetown (Barbados) to Port of Spain and the vanguard had to stay overnight on Barbados. Moreover, no work was also possible during the 29th when the harbor of Port of Spain was closed for a security check in view of the near visit of the U.S. president Barack Obama. Thus, unloading of containers and mobilization of heavy gear had to be postponed to the 30th, when also the rest of the scientific party arrived save and sound on board. Work proceeded well and could be closed by a successful harbor test of the ROV in the morning of April 2nd. During the 3100 nm long transit to the hydrothermal sites at the MAR, concentrations of halogenated organic compounds in the atmosphere and the surface waters were continuously measured by a team of the IfBM, University of Hamburg. The objective of this work, performed under the auspicious of the excellence cluster CLISAP, is to shed light on the relevance of tropical coastal zones for the atmospheric burden of halogenated molecules. FS Meteor crossed the equator in the early morning of April 11th. To avoid any hindrance of the work ahead by force majeure, we took care to enter the southern hemisphere with the whole crew being orderly baptized. We had a nice time during the ceremony and the following party. This Easter will for sure be memorized as one having been very special and enjoyable. At April 12th the first of three Argo Floats launched on behalf of the BSH at 1°S, 24°W. At this opportunity, a launch and recovery test was performed using a dummy of the AUV. Also at April 12th, recording of bathymetry and water currents were started using the ship based EM 120 and ADCP, respectively. A second Argo Float was launched Easter Monday at 03°S, 18°W.

15.04.
After having reached the working area in the early morning, a CTD station was carried out to record a sound velocity profile. Due to entrained water in the main plug, the station had to be abandoned. It followed the first ROV station aimed to take fluid samples of the smokers at the "Turtle Pits" vent field. However, the ROV had to be brought back on deck before any work could be realized due to loss of hydraulic oil. Thereafter, three transponders needed to navigate the AUV were deployed and located in the working area at 5°S.. Having done this successfully, the first CTD station could be completed. The day ended by CTD stations including water sampling for Helium and other gases, and a wax corer (VSR) station.

16.04.
Volcanic glass and rock chips were recovered by VSR until morning. Then, the AUV was launched for detailed mapping of the area south of "Turtle Pits". To problems with the parameterization of the new propeller the station aborted. We thus performed a second ROV-

dive but faced similar problems than the day before. However, during about 1 hour bottom time we could get a mussel sample. A following attempt to calibrate the AUV-propeller failed as the vehicle could not get its position properly. Obviously, the GPS-system was, at least partly, damaged.

17.04.
Night work proceeded by one CTD followed by a VSR station. From 07:30 until 14:00, the first part of the bathymetric data of the working area was recorded by the EM 120 system of Meteor. Next, the 50th dive of the ROV Kiel 6000 was on schedule. Main objective of this dive was to learn whether we had overcome those problems faced during the earlier dives. Though started with cautious expectations, it became an enjoyable and fruitful jubilee dive. Going down at Comfortless Cove, we quickly found the black smoker "Sisters Peak". A sample of about 30kg of massive sulfide could successfully be placed on the porch of the ROV. Flying on, we entered "Golden Valley" again an impressive and beautiful sight with mussels densely covering the walls of an about 3 m wide fissure. The ROV was based in front a white colored hill, assumed to represent rocks overgrown by bacteria. When trying to sample these microbial mats by a net, we cracked the surface and hot smoke merged from the hole destroying the net. The hill showed to be composed of massive hydrothermal sulfides and to contain hot fluids below a thin sulfide crust. This observation sheds new light on the processes supporting the dense hydrothermal fauna at "Golden Valley". After having sampled mussels using a second net, a chunk of basaltic rocks with abundant mussels attached could be secured. The ROV was recovered at 22:00 on deck and CTD work followed.

18.04.
After having performed two CTDs and one VSR, the ROV was applied to investigate the Turtle Pits vent field including the smokers One Boat, Two Boats, and Southern Tower which all three emitting extremely hot fluids. The smokers were found shortly after bottom view, however, sampling of fluids became a severe problem. All sources emitting the desired hot fluids were located at the upper zone of these smokers being several meters in height and none was easy to reach by the vehicle. However, we finally succeeded to obtain two Ti-Majors samples from One Boat chimney and to realize a temperature measurement by KIPS showing extraordinary high temperatures exceeding 400°C. This was made possible by the skilled work of the ROV-team until midnight when the ROV was regained on board Meteor. Thank you for the successful dive!

19.04.
The day was highlighted by the first complete ROV-dive focused on biological work (ROV 287). At early morning, the AUV was launched together with a Zodiak. To overcome the problem in obtaining sufficient satellite data for positioning, we intended to hold a signal amplifier close to the AUV-GPS-antenna. However, after trying hard we had to give up due to the extraordinary bad weather conditions. An extended pressure low caused stronger, permanently turning winds together with a high sea stage of 2-3 m. It rained almost the whole day. Two VSR stations could be realized until the ROV was sent to the water at 14:30 aiming to land close to the low-temperature vent fields Golden Valley and Clueless to find a place

offering diffuse outflows of warm waters and abundant easy to reach mussel patches. After the ROV touched bottom, no such place could be found while searching for about 4 hours. However, then an appropriate sampling station were discovered. after having decided to extend the dive time until 23:00, including temperature measurements fluid sampling by KIPS and implanting “Die Fast” and gathering mussels.

20.04.09
While the ROV needed a day of maintenance after the extensive work it performed during the last days, the day started with the 2 CTD located south of Turtle Pits and a VSR. At 08:00, the AUV was given another try by circumnavigating the hardly working GPS-unit by attaching an amplifier to the AUV-antenna from a Zodiac until the vehicle had got the position was ready to dive. Though this was successful, the AUV moved to slow as no proper parameters were still available for the propeller and dive had to be abandoned. During the attempt to change these parameters for a second try, some problems with entrained water into the amplifier came to light and thus the station work with the AUV had to be stopped. Thus, we proceeded bathymetry by the EM 120 to complete the area map until 23:00. to go on with CTD stations.

21.04.
CTD work and a successful VSR preceded a ROV-dive dedicated to the “Red Lion” hydrothermal system. After launching the ROV at 08:00, the four smokers “Shrimp Farm”, “Tannenbaum”, “Mephisto”, and “Sugarhead” were found without problems. All of them appeared to be more active compared to the observations in 2006 and 2008. Fluid temperatures of 353°C were measured at “Tannenbaum” and “Mephisto”, and the latter was sampled by KIPS, whereas an attempt with a Ti-Major failed. Thereafter, the ROV fled SSE in direction to “Comfortless Cove” vent field for observing several elevated structures, which were found to be small pillow mounts. Along the about ½ nm long pass, a frequent change between pillow lava, lobate lava (overlying hacky lava), hacky lava and sheet flows was observed. Following a prominent fissure striking about 10°, we entered “Golden Valley” and, south of it, most probably “Clueless”. After the ROV was recovered on deck at 20:30, work proceeded by oceanography.

22.04.
Having completed a CTD and a VSR station, a last try was undertaken to get the AUV on track for mapping. However, though trying hard two times we failed. Thus, we have to wait until the vehicle is fixed by spare parts we shall obtain at Ascension Island. At noon, the ROV was launched to investigate the smoker “Sister Peak” and especially the diffuse hydrothermal field “Clueless”, both located in the area “Comfortless Cove”. With the help of an improved Posidonia under water navigation system and the experience from the last dive, we could quickly find the locations and accomplish the entire suite of planned work. This mainly concerned microbiological studies and investigations of mussels, shrimps and their symbionts.

23.04.

During the early day, one CTD and one VSR were followed by a try to release a mooring placed about on year ago. However, no mooring came in sight at sea surface. After sunrise we released and collected the three AUV-transponders deployed 8 days ago.
The seventh ROV-station, made possible by the skilled work of the ROV-Team, led us from the hydrothermal area "Turtle Pits" located in the south of the working area along a about ½ nm track to the black smoker "Sister Peak". The ROV touched bottom directly within the field of active and extinguished smokers of "Turtle Pits". An attempt to obtain a sample of hot fluid had to be aborted as no appropriate parking position could be found for the ROV. We could not find a place where the sight was not hindered by smoke or the top of the vehicle was not endangered by the exhaling hot fluids. Thus we headed to three little mounds located about 260m north of "Turtle Pits" crossing a mussel field at vents of shimmering waters.. The mounds were found to be composed of hydrothermal precipitates. One appeared to be a mound of massive sulfides much larger than all other sites so far observed in the working area, even no black smoke but only vents of shimmering water could be found. The other two are most probably composed of iron oxides rich in silicic acid and represent a late hydrothermal stage with emanations of fluids prone in hydrogen sulfide and metals but enriched in silica. After the exiting view on these mounds we turned east to cross mainly fairly sedimented basalt sheet flows suggested to originate from south east. After about 300m the morphology became much rougher with sheets of lobate lava, jumbled lava, lava domes, sky lights, and pillars. We continued flying NNE heading to "Sister Peak" and observed several mussel patches where warm waters emerged from the sea floor and a pillow mount about 100m south of Sister Peak.

24.04.
Until early morning, the bathymetric map of the area harboring the active hydrothermal fields "Red Lion", "Comfortless Cove", and Turtle Pits by ship based EM 120 system. At 06:00 we steamed to the next working area, the Inside Corner High located at 5°S and launched the ROV. The dive concentrated on the upper zone of the high and started traversing 500m along an about 30m thick mylonitic horizon to continue by exploring the top of the structure. Beside comprehensive footage we gained 17 rock samples. From the evaluation of this material more insight into the processes responsible for the generation of the huge elevated complexes found at the edge between the spreading zone and transform faults are expected. After recovery of the ROV at 22:00, time until morning was covered by bathymetric mapping of the area.

25.04.
In the early morning Meteor started the about 240 nm long transit to Ascension Island. The evening was used for a barbeque on deck.

26.04.
Having arrived at Ascension Island at sunrise, a TV team of 4 persons were embarked in exchange for 4 scientists and Meteor steamed to the hydrothermal working area "Nibelungen" with the active site "Drachenschlund". After arrival at noon, the ROV was launched aimed to get samples of hot fluids emitted from the smoking crater "Drachenschlund", one of the few hydrothermal sites hosted by ultramafic rock, and. of inactive chimney structures present in its

surrounding. Work was very much adapted to the requests of the TV-team also taking pictures within the control container of the ROV. A sample of an inactive chimney was recovered for investigation of the biological decomposition of massive sulfides at the seafloor. The night was spent in recording a bathymetric map.

27.04.
A second try to obtain samples from the "Drachenschlund" by using a spear, an about 2 m long steel baton with the KIPS-nozzle on top hold by the Rickmaster of ROV was successful. However, the ROV was requested to leave water at sun down, and thus remained for some hours at 300m depth, not to the benefit of the samples. Bathymetric mapping of the "Nibelungen" area occupied the night.

28.04.
The day was dedicated to filming until 17:00 when the TV-team disembarked to Ascension Island. With the again completed scientific team FS Meteor steamed heading to the last working area "Lilliput", an active hydrothermal region with common occurrence of diffuse venting accompanied by rich vent fauna and especially symbiotic mussels.

29.04.
Having arrived at "Lilliput" by early morning, two transponders for the planned AUV work were located and the AUV was launched. Though the AUV started the mission properly, it aborted after about 1 hour, most probably due to data overload. We thus sent down the ROV to the hydrothermal field "Main Lilliput", where diffuse outflows and associated fauna had been discovered at 1500 m depth during cruise M64/1 in 2005. While the ROV having quickly found the active sites was underway to survey the surroundings of "Lilliput", the AUV was launched for a second time with the multibeam system switched off. The AUV-team, having tried really hard throughout the cruise, became finitely rewarded by a successfully completed 7 hours long mission, gorgeous! Also the ROV worked perfectly. An extended program on the biology of vent mussels was realized and we started an investigation on the influence of tides on diffuse sources and the associated microbiology. In this context, an instrument was located in a selected vent for recording temperature over an extended time period of days. Both, ROV and AUV were recovered on deck at about 21:00. CTD work including a Tow-yo was done through the night and dedicated to the exploration of a hot hydrothermal vent within the blown up ridge segment "Lilliput" is located on.

30.04.
Today's ROV-dive started in the northeast of "Lilliput" at 09°32.6'S, 013°12.8W and went south exploring the westerly arm of the mound chains west of "Lilliput" down to 09°33.15'S. We observed unsedimented pillow lavas, lava flows and jumbled lavas cut by deep and up to 10m wide N to S striking fissures. Then we turned east to enter "Limtoc" showing occurrences of iron-oxides and lava sheets with skylights and even larger collapse structures. We finally went to "Main Lilliput" for sampling. During the ROV dive, the AUV mapped the area centered at 09°31.3'S, 013°11.8'W for Eh and turbidity anomalies 50m above seafloor, where last night's CTD work had shown enhanced turbidity and decreased Eh-values. The

night was covered by CTD work, aimed to obtain more information for searching a hot hydrothermal vent by ROV the following day.

01.05.
After the early morning was covered by bathymetry, the ROV was launched at "Main Lilliput to proceed with the studies on tidal effects. Having done this, the ROV flew about 2 nm to the north east where indications of possible hot venting had emerged from CTD records and last day's AUV-mapping by anomalies in turbidity and Eh values. In parallel, the AUV performed another mission in that area by mapping Eh values flying at a water depth of 1530m. However, the ROV survey of the northeastern corner of "Lilliput" showed basaltic lava of enhanced age (as deduced from considerable coverage by sediment) penetrated by N - S striking faults, but no signs of any hydrothermal activity. The night was spent trying to obtain more information on hot venting by two CTD Tow-Yos.

02.05.
A thorough evaluation of the data obtained by CTD and AUV bearing indications for a possible presence of a hot source in the northeastern part of "Lilliput" led to the decision to truncate the search. We could not narrow the area where the hot source should be located sufficiently to allow finding it by ROV with good change. Moreover, at least part of the observed anomalies appeared to be possibly related to resuspension of sediments. Thus, the last ROV-dive started at "Main Lilliput" and went south across "Limtoc" and "Roman City" to investigate the so far unknown southernmost area.
During the ROV dive, the AUV recorded a high resolution bathymetry of the "Lilliput" area. Further on, CTD stations were performed on the "Roman City", "Limtoc" and "Main Lilliput" known to emit low tempered hydrothermal fluids, and the bathymetric map of region around "Lilliput" was completed using the ship based EM 120 system.

03.05.

After the bathymetric mapping, the AUV transponders were released and collected and FS METEOR left the MAR in direction to Rio de Janeiro at noon. The measurements of concentrations of halogenated organic compounds in the atmosphere and the surface waters were restarted by a team of the IfBM, University of Hamburg.

04. to 11.05.
At the evening of May 4th, the third NEMO (Argo float) was launched at 12°S, 18°30'W. The last stations of the cruise were performed May 6th 12:00 at 16°10'S, 26°20'W at water depth of 6000m. Both, the ROV and the AUV were launched to dive to their limit. While the AUV did the planned mission at 5900m, even with the multibeam echosounder system switched off, the ROV dive was stopped at 4500m due to malfunction of the propellers and severe leakage of hydraulic oil system supplying the Orion. After the end of station work, FS METEOR continued her transit at 19:45 to Rio de Janeiro to moor in Rio de Janeiro in the morning of May 11th.

2.4 Preliminary Results

2.4.1 ROV Kiel 6000 and its operation during the HYDROMAR VIII Cruise

(F. Abegg, M. Pieper, C. Hinz, H. Huusmann, I. Suck, A. Foster, P. Rodriguez, S. Petersen)

The ROV (remotely operated vehicle) Kiel 6000 is a 6000 m rated deep diving platform manufactured by Schilling Robotics LLC. As an electric work class ROV from the type QUEST, this is build no. seven, and is based at the Leibniz Institute for Marine Sciences IFM-GEOMAR in Kiel, Germany.
The whole ROV equipment was shipped to Trinidad from the previous cruise which ended in Martinique. The equipment arrived in good shape and was loaded onboard RV METEOR beginning March 30th. From then on, the whole system was set up, which was finished with the harbour test before noon 2nd of April.
The UHD vehicle is equipped with 7 brushless thrusters, with 210 kgf peak thrust each. Power is supplied through the umbilical with up to 4160VAS/460 Hz. The data transfer between the vehicle and the topside control van is managed by the digital telemetry system (DTS™) which consists of two surface and four sub-sea nodes, each representing a 16-port module. Each port may be individually configured for serial, video or ethernet purposes.
The vehicle is linked to the topside control unit via a 19 mm diameter wire. No tether management system (TMS) is used. To unlink the vehicle from ship's movements, floats are attached to the umbilical. For more details please visit www.ifm-geomar/kiel6000.

Fig. 2.4.1.1: View of the ROV Kiel 6000 front with cameras, manipulators and tool sled

Tools standardly installed on the vehicle include a HDTV camera, two high-resolution colour zoom cameras and one digital still camera as well as four black and white observation cameras. Besides the video capabilities the two manipulator arms are the major tools used on this platform. One is a seven-function position controlled manipulator of the type ORION and the other one is five-function rate controlled manipulator, type RIGMASTER. Further tools include a DIGIQUARTZ depth sensor, a SIMRAD sonar system, a PNI TCM2-50 compass, a motion reference unit (MRU) containing a gyro compass, and an RDI doppler velocity log (DVL). A further tool used especially for navigation is the USBL-based IXSEA POSIDONIA™ system. Additionally a SONARDYNE HOMER™ system is available as a tool for navigation within a certain area of interest which has been marked with one or more HOMER beacons.

The tool sled in the lower-most part of the vehicle is especially dedicated to take up the scientific payload. A SBE 49 FastCAT CTD is permanently mounted. Located on portside front of the tool sled is a sample tray which can be

opened hydraulically. On starboard front there is a drawer likewise hydraulically driven, which can take up probes used by the manipulator. Port aft and starboard aft are reserved for additional scientific payload which may differ from mission to mission.
During M78-2 the starboard aft side was occupied by the KIPS fluid sampling system with its sampling nozzel and temperature probe on the starboard drawer. Because of the difficult sampling conditions at the Drachenschlund site within the Nibelungen Field, an extension rod with a second KIPS nozzel was mounted on the Rigmaster manipulater. This construction allowed sampling of the 'hidden' Black Smoker. Additional tools used for scientific samples during this cruise were musselnets, a sample box with lid, a sample barrel with lid, Die Fast I and Die Fast II, titanium major bottles, scratch shovel, Smoni, 8-channel temperature logger, passive markers and Helium sampling tubes. Details of these tools are given in the respective chapters. Occasionally, the left side was occupied by a rotary sampler which was fed by a slurp gun array.

Tab. 2.4.3.1: Summary of dives during HYDROMAR VIII

Station # M78-2	Dive No.	Date	Time Start (UTC)	At Bottom (UTC)	Off Bottom (UTC)	Time End (UTC)	ROV Bottom Time	% Bottom Time	Location
	47	02.04.2009							Harbour Test
260ROV	48	15.04.2009	11:15	13:06	13:34	14:53	00:28	12,8	Turtle Pits/Red Lion
267ROV	49	16.04.2009	13:09	14:50	16:14	17:35	01:24	31,6	Foggy Corner
274ROV	50	17.04.2009	16:32	18:07	21:19	22:45	03:12	51,5	Foggy Corner
281ROV	51	18.04.2009	16:42	18:01	23:25	00:40	05:24	67,8	Turtle Pits
287ROV	52	19.04.2009	14:39	15:55	22:17	23:27	06:22	72,3	Golden Valley
297ROV	53	21.04.2009	09:06	11:14	19:55	21:12	08:41	71,7	Red Lion
302ROV	54	22.04.2009	13:12	14:30	00:00	01:18	09:30	78,5	Clueless/Golden Valley
308ROV	55	23.04.2009	13:05	14:27	22:04	23:33	07:37	72,8	Turtle Pits
310ROV	56	24.04.2009	12:19	13:11	21:45	22:33	08:34	83,7	Inside Corner High
312ROV	57	26.04.2009	15:05	16:31	20:56	21:45	04:25	66,2	Nibelungen/ Drachenschlund
314ROV	58	27.04.2009	09:53	11:10	16:12	18:39	05:02	57,3	Nibelungen/ Drachenschlund
319ROV	59	29.04.2009	11:04	11:50	21:25	22:08	09:35	86,6	Lilliput
324ROV	60	30.04.2009	11:04	11:52	19:57	20:45	08:05	83,4	Lilliput
329ROV	61	01.05.2009	09:41	10:46	20:58	22:07	10:12	82,1	Lilliput
335ROV	62	02.05.2009	11:44	12:35	21:46	22:39	09:11	84,1	Lilliput/ Roman Ruins
343ROV	63	06.05.2009	14:43			20:05			Deep Dive Test
Total: 15 scientific dives							**97:42**	**72,1**	

Due to the perfect weather conditions, we were able to carry out 15 scientific dives, 9 in the 4°48' S and Inside Corner High area, two at the Nibelungen site (8°18' S) and 4 within the Lilliput area (9°33'S), summing up to more than 97h bottom time. The last dive was used to perform a deep dive test of the ROV Kiel 6000 at 16°9' S 26°18' W.

2.4.2 AUV dives

(K. Lackschewitz, M. Rothenbeck, J. Sticklus)

Technical description

The Autonomous Underwater Vehicle (AUV) ABYSS (built by HYDROID) from IFM-GEOMAR can be operate in water depth of up to 6000 m.
The ABYSS system comprises the AUV itself, a control and workshop container, and a mobile Launch and Recovery System (LARS) with a deployment frame that is installed at the starboard side on the afterdeck of R/V METEOR. The self-contained LARS was developed by WHOI to support ship-based operations so that no Zodiac is required to launch and recover the AUV. The LARS is mounted on steel plates which are screwed on the deck of the ship. The LARS is configured in a way that the AUV can also be deployed over the port or starboard side of the German medium and big size research vessels. The LARS is stored in a 20 ft. container during transport.
We can deploy and recover the AUV at weather conditions with a swell up to 2.5 m and wind speeds of up to 6 beaufort. For the recovery the nose float pops off when triggered through an acoustic command. The float and the ca. 25 m recovery line drift away from the vehicle so that a grappnel hook can snag the line (Fig. 1A). The line is then connected to the LARS winch, and the vehicle is pulled up (Fig. 1B). Finally, the AUV is brought up on deck and safely secured in the LARS (Fig. 1C). During M78/2 every deployment and recovery with the LARS occurred without any problems.

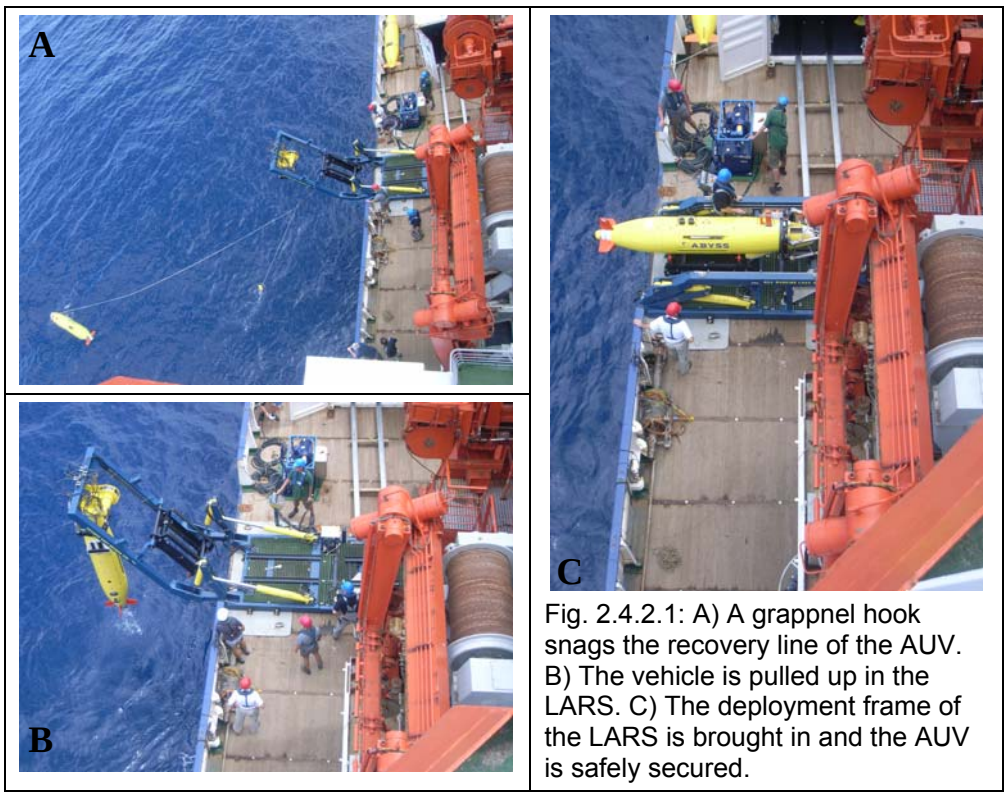


Fig. 2.4.2.1: A) A grappnel hook snags the recovery line of the AUV. B) The vehicle is pulled up in the LARS. C) The deployment frame of the LARS is brought in and the AUV is safely secured.

The vehicle consists of a tapered forward section, a cylindrical midsection and a tapered tail section. An internal titanium strongback, which extends much of the vehicle length, provides

the structural integrity and a mounting platform for syntactic foam, equipment housings, sensors and release mechanisms. The maximum vehicle diameter is 0.66 meters and the overall length is 4 meters. Vehicle weight is, depending on the payload, approximately 880 kilograms. A rectangular compartment in the midsection of the vehicle contains three pressure housings and an oil-filled junction box. Two pressure housings each contain one 5.6 kWh 29-Volt lithium-ion battery pack. The third pressure housing contains the vehicle and sidescan sonar electronics. The vehicle's inertial measurement unit and acoustic Doppler current profiler are housed in two other independent housings that are mounted forward of the 3 main pressure housings. The propulsion and control systems are located in the tail assembly, which bolts to the aft face of the vehicle strongback. The tail assembly consists of a pressure housing with motor controller electronics, and an oil-compensated motor housing. Propulsion is generated with a 24 VDC brushless motor driving a two-bladed propeller. However, some technical issues occured due to a new propeller provided by the manufacturer. The first dive in a water depth of 3000 m during leg M78-2 has indicated errors in the given prop parameters. The problem was identified and could be successfully fixed after a few tests. As a result, the system proved to be fully operational in water depth until 5900 m during M78-2. Control is achieved with horizontal and vertical fins driven by 24 VDC brushless gear motors. The vehicle velocity range is 1.2 to 2.0 m/s, although best control is achieved at velocities above 1.5 m/s. The AUV dives descent with about 0.9 m/s whereas the ascent time is about 0.5 m/s or 1m/s if ascent weight is dropped. Together with the deployment/recovery procedure the descent to the seafloor and the ascent back to the vessel take approximately 3 hours at a water depth of 3000 m.

Sensors of the base vehicle include pressure, temperature, conductivity, optical backscatter and eH-sensor (in cooperation with Dr. Koichi Nakamura, Japan); and an inertial navigation system that is aided by an Acoustic Doppler Current Profiler (ADCP) with bottom lock capabilities.
In addition, the vehicle can be reconfigured for three different modes of operation as follows
1. Base vehicle plus RESON Seabat 7125 Multi-Beam (200/400 kHz), or
2. Base vehicle plus Electronic Still Camera & Strobe (not used during M78/2), or
3. Base vehicle plus EdgeTech Dual Frequency (110/420 kHz) Side Scan Sonar and Sub-Bottom Profiler (not used during M78/2)

All sensor information collected by the vehicle is marked with time, depth and latitude, and longitude as it is collected, facilitating the rapid and highly automated generation of maps and HTML based reports. An acoustic communication system permits the vehicle to send status messages to the surface ship containing information about the vehicle's health, its location, and some sensor data while it is performing a mission at up to 6 km below the surface. The acoustic communication system is also used to send data and redirection commands to the vehicle. The AUV utilizes electronics, control software, and the laptop based operator interface software.

The vehicle navigates autonomously using a combination of navigation methods:
• **GPS** - Works only on the surface, GPS determines the vehicle's location on Earth. GPS

determines the "initial position" before the vehicle submerges, and verifies or corrects the vehicle's position when it surfaces during the mission. GPS also plays a critical role during INS alignment.

• **Inertial Navigation System (INS)** - After alignment on the surface, INS continuously integrates acceleration in 3 axes to calculate the vehicle's position. It uses input from the DVL and the GPS to maintain its alignment.

Unfortunalely, during M78/2 the internal GPS of the vehicle received significantly weaker satellite signals after the first AUV station. The problem couldn't be solved although we changed the antenna and the GPS receiver and repeater boards. However, before diving an external GPS repeater was mounted over the antenna to maintain the INS alignment which worked for the reminder of the dives.

• **Doppler Velocity Log (DVL)** - Continuously measures altitude and speed over ground whenever the vehicle can maintain bottom-lock. The DVL receives temperature and salinity data from the CTD Probe to calculate sound speed. The DVL must be within range of the bottom to measure altitude and provide bottom-lock for the INS.

• **Long Baseline Acoustic Navigation (LBL)** - The vehicle can navigate using LBL navigation by computing its range to two (or more) moored acoustic transponders.

A Vehicle Interface Program (VIP), a Windows program that manages every aspect of AUV operation, include the following tasks:

• Mission planning on electronic navigation charts (customizable, multi-format)
• Real-time mission monitoring through the acoustic modem
• Real-time support-vessel position and heading through GPS and compass feeds
• Pre-mission system checkout
• Post-mission data analysis, mission play-back, and side-scan review

Navigation charts show missions during planning, operation, and review. A graphic Mission Planner lets users build mission files using drag-and-drop to position waypoints and mission objectives on the chart window, and fine-tune missions using editable text fields. Automatic error checking verifies all aspects of planned missions, and warns operators if any mission parameters are incorrect. Communication between the vehicle and the computer runs through a standard Ethernet connection, or wirelessly, using the WiFi connection.

First results

Four dives were completed in the „Lilliput" area (9°30'S), ABYSS dives 6-9 were dedicated to hydrothermal exploration and high-resolution mapping.

ABYSS 6 (M78/2-320) did a water column investigation (e.g. hydrothermal plume survey) north of the known diffuse venting areas of Lilliput. The survey lines were conducted 120 m above the seafloor with 200 m line-spacing. The survey area showed no substantial hits on Eh, turbidity, or temperature. The survey distance was 28.7 km.

ABYSS 7 (M78/2-325) was another dive to continue exploration in the northeastern area of „Main Lilliput“. The dive was conducted at a fixed height above the seafloor (50 m) with 100 m line spacing centered on a located CTD tow-yo plume signal (see M78/2-322). The dive recorded significant Eh and turbidity signals in the northern part of the survey (Fig. 2). ABYSS flew a survey distance of 23.7 km.

Based on the results of dive 7, ABYSS 8 (M78/2-330) dive was chosen to map the plume signal further to the north. The dive was planned with a constant water depth of 1530 m and a 100 m line-spacing. In addition, we used the 200 kHz multibeam sonar for detailed bathymetric mapping on a survey distance of 32.3 km (Fig. 5B). The dive recorded significant eH and turbidity anomalies ca. 100m above the seafloor in the NW corner of the survey track but approximately 1 km NW of where the anomalies of dive 7 were detected.

ABYSS 9 (M78/2-336) was conducted to carry out high-resolution bathymetric mapping (400 kHz multibeam sonar) of the Lilliput Sites and to continue plume exploration at constant water depth of 1440 m with 80 m line-spacing.

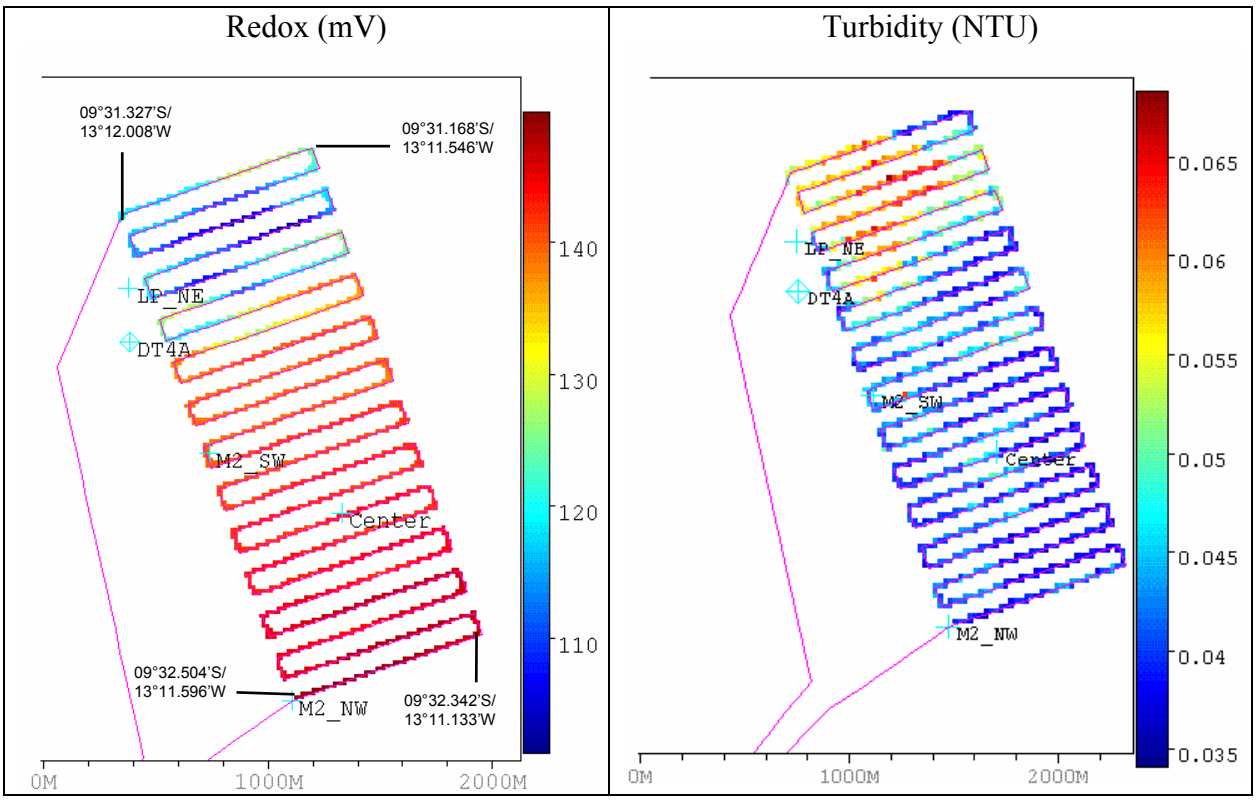


Fig. 2.4.2.2: Eh and turbidity data for ABYSS 7 dive.

From Eh and turbidity records, the two most significant hits were recorded over the „Limtoc“ and „Roman City“ diffuse venting areas (Fig.4). ABYSS surveyed 30.6 km on track during approximately 6 hours. Fig. xy shows a detailed bathymetric map of the area of the Lilliput field from the ABYSS Reson multibeam (Fig. 5A).

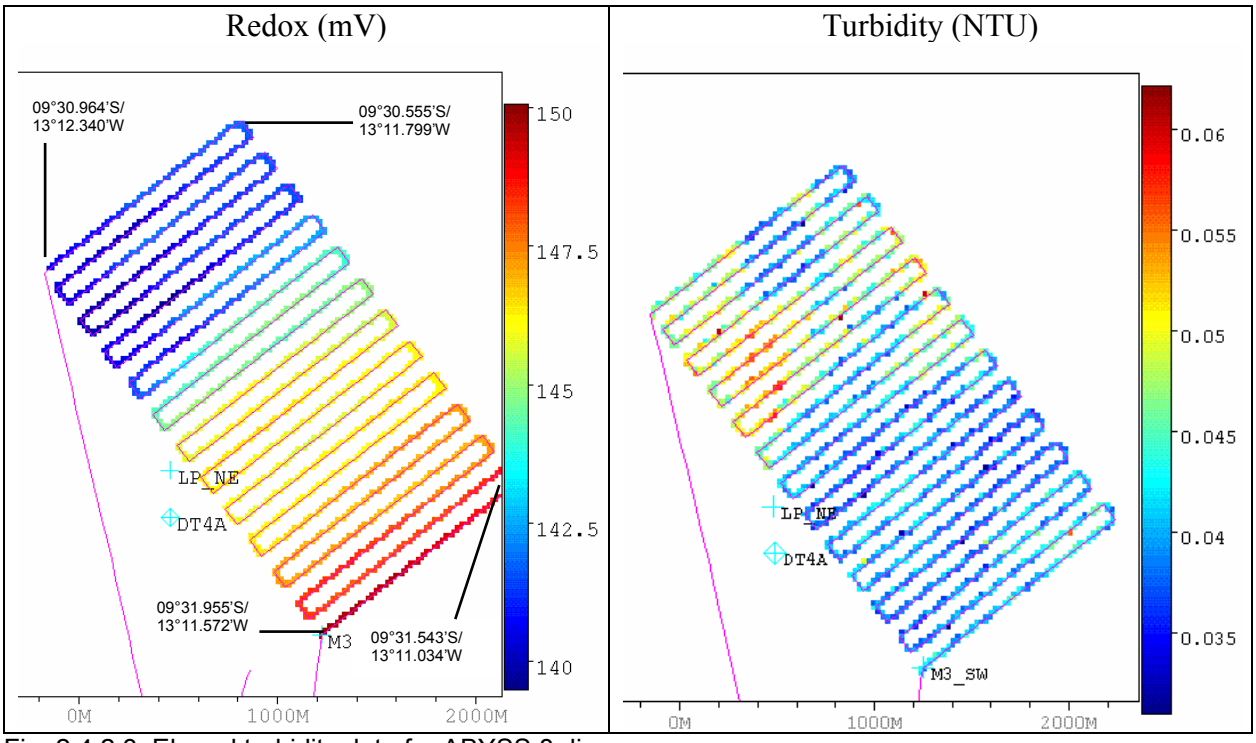


Fig. 2.4.2.3: Eh and turbidity data for ABYSS 8 dive.

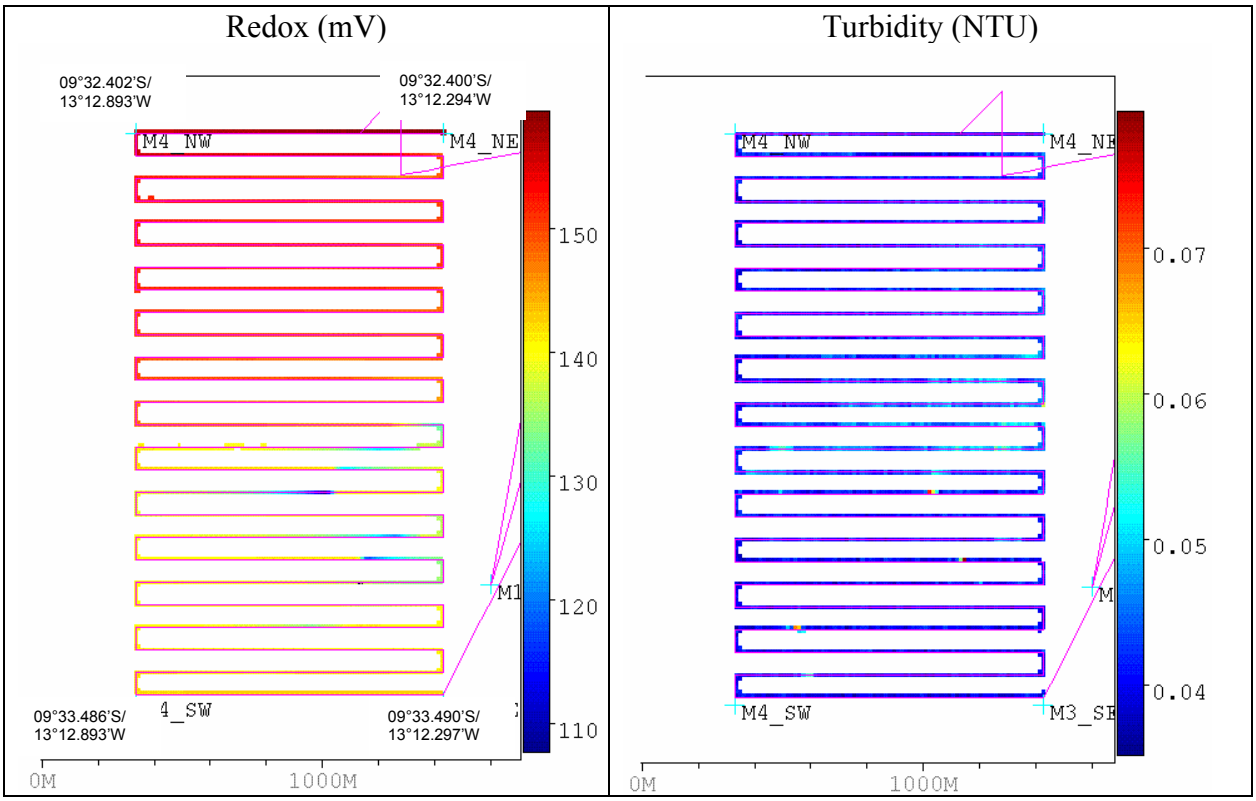


Fig. 2.4.2.4: Eh and turbidity data for ABYSS 9 dive.

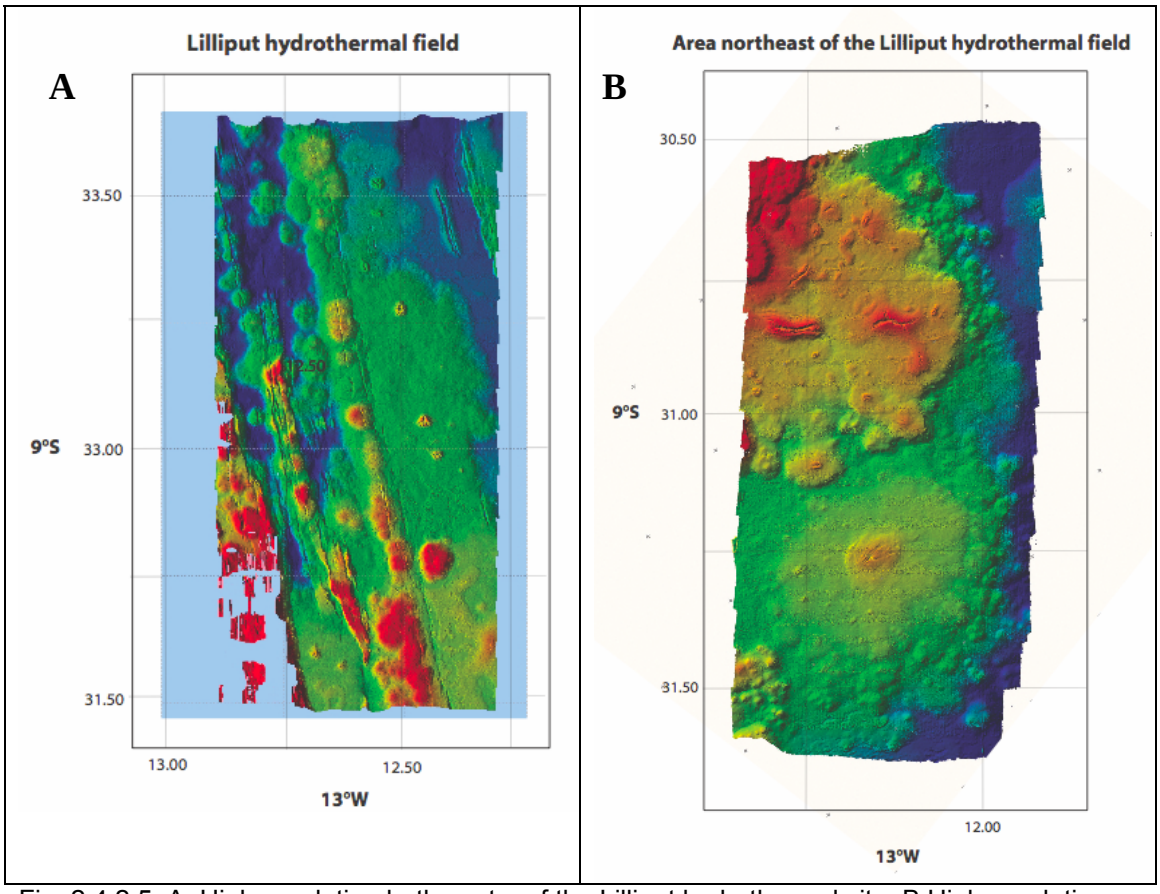


Fig. 2.4.2.5: A. High-resolution bathymetry of the Lilliput hydrothermal site. B.High-resolution bathymetry of the area northeast of the Lilliput hydrothermal site

2.4.3 Geological Observations and Sampling

J. Koepke, S. Petersen, H. Strauss, C. Breuer

This chapter describes the hard rocks recovered during the various stations as well as three subchapters dealing with the geological observations obtained during ROV dives. Three types of hard rocks were sampled during the M78/2 cruise: volcanic rocks from the rift valley, mafic and ultramafic rocks from the Inside Corner High at 5° South, and hydrothermal precipitates from the different vent systems.

2.4.3.1 Volcanic Rocks

The volcanic rocks in the region have been sampled using the wax corer (VSR stations) and the ROV. Table xy summarizes the rock samples obtained during this cruise.

Details of operations

We used "Vaseline" as medium for collecting basalt fragments, and it turned out that this material is obviously too soft at equatorial temperatures, with the risk of losing the whole vaseline mass including basalt chips out of the front tube before having the VSR back on deck. To avoid this, we used a 40 cm net held by a ~ 4 m long stick (Meteor facility) and fixed a bucket inside the net. As soon as the VSR was pulled above sea level, we held this tool under the front tube of the VSR, in order to catch the Vaseline mass in case of loosing.

We made different attempts to optimize the winch condition:

1. 5 minute stop 50 m above seafloor; then winch velocity of 1 m/s
2. 5 minute stop 20 m above seafloor; then winch velocity of 1 m/s
3. 5 minute stop 20 m above seafloor; then winch velocity of 0.5 m/s

Most VSR stations were performed with the second option.

Table 2.4.3.1 Summary of all volcanic rocks sampled during the cruise M78/2

Station / Sample#	***Lat.***	***Long.***	***Depth***	***Comment***
Turtle Pits area				
VSR 265	04°48.340' S	12°22.330' W	2976m	Objective: Sample small pillow mound south of Comfortless Cove; Is this a young eruptive center? Recovery: 0.1 g basalt chips (most of the sample lost)
267ROV-5	04°48.161' S	12°22.330' W	2987m	Locality "Foggy Corner" : 10 g glassy chips co-sampled in the mussel net; phenocryts of plagioclase visible
267ROV	04°48.161' S	12°22.330' W	2987m	Locality "Foggy Corner" : Some glassy chips lying on the porch somewhere from the location "Foggy Corner"
VSR 269	04°48.479' S	12°22.209' W	2966m	Objective: Sample small pillow mound northeast of Wideawake; Is this a young eruptive center? Recovery: 50g of fresh basalt chips

Station / Sample#	*Lat.*	*Long.*	*Depth*	*Comment*
VSR 272	04°48.265' S	12°20.987' W	2864m	Objective: Sampling of the bathymetric minimum east of Turtle Pits. Recovery: 5g of basalt chips with some sediment
274ROV-4	04°48.166' S	12°22.280' W	2987m	Locality "Golden Valley": Several kg lava block with mussels; shows glassy rinds which were sampled separately; glass contains plagioclase phenocrysts; rock probably altered
VSR278	04°44.797' S	12°22.909' W	3110m?	Objective: Sampling of a volcanic mound in the center of the rift valley 2.5 nm north of Red Lion. No clear bottom contact; steep slope. Recovery: EMPTY, reason for this unclear; copper lever ring inside the tube damaged after operation; not clear why
VSR280	04°48.763' S	12°20.991' W	2929m	Objective: Sample elevated lava field east of Turtle Pits and south of station VSR272; is this also an older flow? Maximum cable out: 2931m; Recovery: 100g of sediment with mm-sized basalt chips.
VSR285	04°49.196' S	12°21.722' W	2890m	Objective: Sample pillow mound south of Turtle Pits; possible eruptive center for young flows at Wideawake? Maximum cable out: 2904m Recovery: Empty
VSR286	04°49.195' S	12°21.722' W	2905m	Objective: Redo previous station. Maximum cable out: 2911m Recovery: very poor; few basalt chips (less than 100 mg) and some grains of sediment suggesting an older age of the edifice.
ROV287-11	04°48.170' S	12°22.249' W	2987m	Locality: "Desperate" near "Foggy corner": 1 g glass chips found in the "Die Fast"; co-sampled
ROV287-12	04°48.170' S	12°22.249' W	2987m	Locality: "Desperate" near "Foggy corner": 1 g glass chips found in the mussel net co-sampled
ROV287	04°48.170' S	12°22.249' W		Two kg-sized blocks of altered pillow basalt with glassy rind coverd with small white "Pocken (probably "Laichballen") on the surface, found on the porch; not clear from where, either" Desperate" or "Foggy corner"
VSR290	04°48.268' S	12°23.609' W	2982m	Objective: Sample lava flows west of Turtle Pits. Maximum cable out: 2987m Recovery: >10g aphyric basalt with some glass and abundant sediment

Station / Sample#	*Lat.*	*Long.*	*Depth*	*Comment*
VSR292	04°50.001' S	12°22.201' W	2994m	Objective: Sample ridge axis 1.5 nm to the south of Turtle Pits, filling gap in previous sampling. Maxim um cable out: 2997m Recovery: ~ 1 g very fresh glass chips; aphyric
VSR296	04°45.601' S	12°22.501' W	3090m	Objective: Sample ridge axis 1.5nm to the north of Turtle Pits, filling gap in previous sampling. Depth variation on ship display ± 3090m → probably strong relief. Depth from friction signal at winch: 3090m Recovery: ~5g very fresh glass chips; mm-sized plagioclase crystals
VSR300	04°45.31'S	12°23.45'W	3155m	Objective: Sample volcanic high 2 nm NW of Red Lion. Maximum cable out: 3170m. Recovery: 0.1g of aphyric fresh glass chips,
VSR303	04°51.00'S	12°22.00'W	3100m	Objective: Sample ridge axis south of Turtle Pits filling sample gap of previous years. Maximum cable out: 3003m. Recovery: 5g basalt chips + few grains of sediment.
308ROV-9	04°48.174' S	12°22.228' W	2987m	Locality "Golden Valley": Several kg lava block with mussels; shows glassy rinds ; glassy chips were picked and stored separately; rock probably altered
Nibelungen area				
314ROV-10A,B	08°17.838' S	13°30.460' W	2897m	Locality: North of Drachenschlund; taken during a hard rock dive to the North; two samples taken from the same locality ; A: with glassy rind; B: heavily altered, altered glassy rind
Lilliput area				
319ROV-8	09°32.837' S	13°12.549' W		Lilliput, co-sampled with "DieFast"; 0.5 g fragments of glassy rinds; covered with Fe-oxides
319ROV-10	09°32.837' S	13°12.549' W		Lilliput, co-sampled with mussel net; 5 g fragments of glassy rinds; covered with Fe-oxides
VSR323	09°31.480' S	13°12.832' W	1508m	Objective: Sample ridge axis North of Lilliput filling sample gap of previous years. Maximum cable out: 1524m. Bottom contact at 1508m; Recovery: 10g of glassy basalt chips containing plagioclase phenocrysts (<1mm).
329ROV-4	09°32.837' S	13°12.832' W		Locality: Main Lilliput; ca. 5 g of slightly altered glassy chips covered with rusty coating

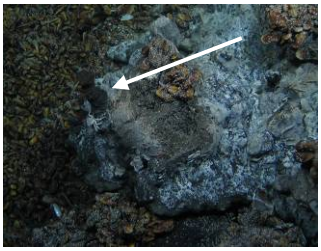
Station / Sample#	*Lat.*	*Long.*	*Depth*	*Comment*
335ROV	~ 09°33.8'S	~ 13°12.4'W		Locality: "South of Roman Ruins" ca. 5 g of slightly altered glassy rind; found on the porch after discovery dive to the area South of Roman Ruins; exact position not clear

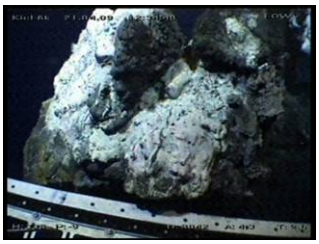
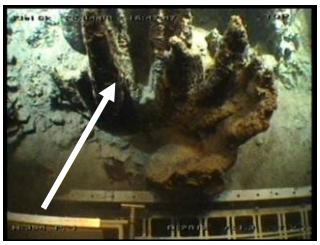
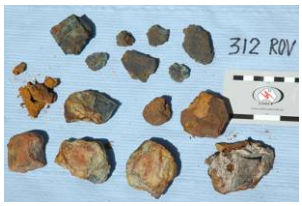
Details of sampling in the Turtle Pits working area

Sampling of the bathymetric minimum to the east of the hydrothermal fields shows the presence of sedimentary material. This suggests a rather old age of this structure indicating that this feature cannot be related to the youngest volcanic activity within the rift valley. This was later confirmed by other VSR stations also containing sediment (stations 280VSR and 286VSR).The bathymetric minimum zone to the east of Turtle Pits is clearly not the source of young lava flows in the area. These must originate from a source closer to the ridge axis (possibly the pillow mounds just outside the AUV-map?).

2.4.3.2 Hydrothermal precipitates

Table 2.4.3.2 Summary of all hydrothermal precipitates collected during the cruise M78/2

sample ID	location	description	bottom photo	sample photo
M78/2 274ROV-1	Sisters Peak trunk 04°48.192'S/ 12°22.310'W 2982m	beehive-like material with massive chalcopyrite core (± pyrite), thin sphalerite enriched layer and up to 1cm thick outer marcasite rim. Some native sulphur (microbial on the surface)		
M78/2 274ROV-2	Golden Valley 04°48.171'S/ 12°22.271'W 2986m	first evidence of sulphide formation here! outer marcasite crust with black to grey sulphide interior. Likely sphalerite, possibly some magne-tite; venting from white crust after substrate was removed		
M78/2 281ROV-7	One Boat 04°48.596'S/ 12°22.422'W 2982m	with Fe-oxyhydroxide coating; accidentally recovered on ROV while parking at the chimney side.		

sample ID	location	description	bottom photo	sample photo
297ROV-1	Mephisto 04°47.843'S/ 12°22.592'W 3042m	sample from the trunk (near top) of the structure consisting of massive pyrite with minor black sphalerite and rare chalcopyrite. Outside is rimmed by marcasite with trace Fe-oxyhydroxides		
302ROV-2	Sisters Peak 04°48.192'S/ 12°22.310'W 2980m	few marcasite bits from the top taken with shovel		
308ROV-1	old mound 04°48.461'S/ 12°22.474'W 2990m	porous pyrite, recrystallized with Fe-oxyhydroxide coating from northern slope of old mound;		
308ROV-11	Sisters Peak ? 04°48.192'S/ 12°22.310'W 2980m	accidentally recovered on porch, location unsure, but likely from Sisters Peak; Zn-rich sample with thin marcasite rust	no image	
312ROV-1	Nibelungen 08°17.887'S/ 13°30.452'W 2912m	old chimney; Zn-rich core with Fe-oxyhydroxide coating; very porous and brittle		
312ROV-2	Nibelungen 08°17.866'S/ 13°30.449'W 2910m	talus from crater rim; pieces of Cu-rich material (chalcosite? 2A) as well as serpentinite (2B) and Fe-oxyhydroxides (2C); Photo right shows the crater rim, but not the actual sampling spot!		

2.4.3.3 Inside Corner High at 5° South

One ROV dive was performed to map and sample the deeper oceanic crust around 5°S (Fig. 1). We investigated the "Inside Corner High" at 5°06'S and 11°40'W (in the following ICH)

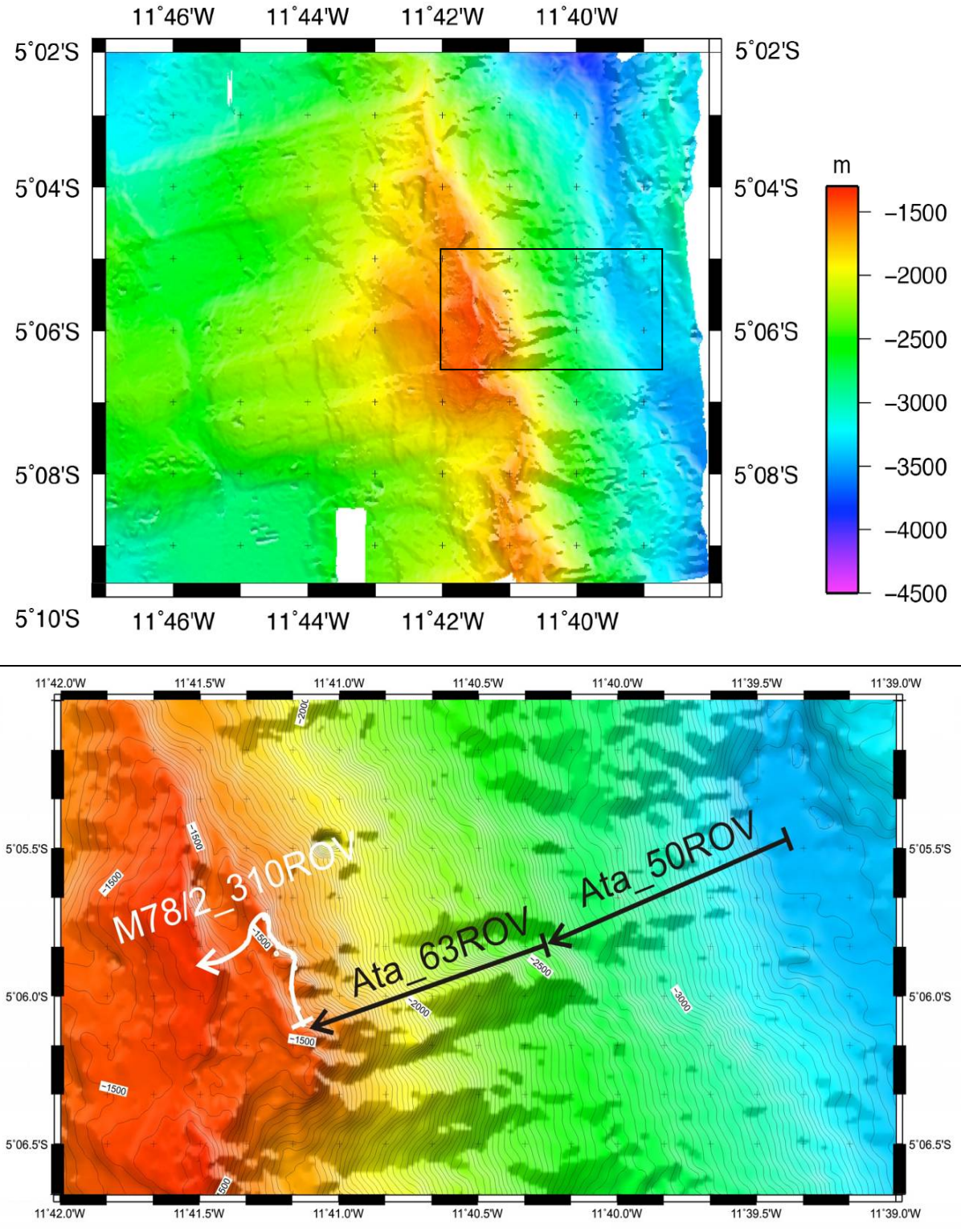


Fig. 2.4.3.1 New bathymetric map of the seafloor topography in the 5°S region obtained during the cruise M78/2 (see 1.4.1). Top: Overview. Visible is the ridge axis in the East and the Inside Corner High with marked corrugations in the center of the image. The inset shows the ROV-investigated area. Bottom: ROV tracks performed in 2008 during Atalante Cruise Leg 2 and during this cruise.

which is regarded as oceanic core complex. These are topographically high standing massifs, typically occurring at inside corners of ridge transform intersections. They are flat topped

with ridge-normal corrugations. They are believed to form by the long-lived activity of a single normal fault, thus exposing deep seated oceanic crust. The reason for strain focusing may be the presence of peridotite screens between gabbroic intrusions. They would act as rheologically weak horizons once they enter the serpentine-stability field.

Previous ROV dives

During the expedition Atalante Cruise Leg – 2 (MARSÜD IV, Ersatz MSM06/3; 07.01.08 Recife to 31.01.08 Dakar) we performed two dives with the ROV Kiel6000 (stations ATA_50ROV and ATA-63ROV) to map and sample the central part of the flank of the ICH (Fig. 2). While climbing 1900 m up the rift wall, the morphology changed from a sediment-covered floor of the rift valley to several hundred meters high, near-vertical cliffs with downdip slickensides and an abrupt transition to the flat-topped region of the core complex. The rock sampled are mainly gabbronorites in the lower part of the rift wall with abundant oxide gabbros in the upper part of the wall. Plagiogranite infiltrations were found in three samples, diabase seems more abundant in the upper part of the rift wall. Only rare olivine-bearing gabbro was recovered. A gabbro mylonite occurs just below the top. The flat-topped region is formed by a peridotite breccia. At the rift base, a diverse suite of peridotite, peridotite mylonite, gabbronorite and olivine gabbro was recovered. Chemical analyses revealed that the recovered rocks have a chemically evolved signature and probably formed in a high level setting with relatively rapid cooling. This is suggested by the ophitic to subophitic textures, locally coarse grained gabbronorites (high water activity?) interleaved with microgabbros and diabases, the presence of abundant plagiogranite infiltrations with sphene, apatite and zircon, and the occurrence of abundant ferrogabbros. The presence of former mantle peridotite is confirmed by Cr-spinel relics (Cr# 45) and Cr-rich amphibole in one peridotite sample. The geochemical and petrological work on these rocks is still in progress. One very interesting rock was sampled at the top of our profile directly below the flattening of complex forming the roof plateau. This sample is an amphibolite-grade ultramylonite derived from a former gabbro. First geothermometric calculations reveal equilibration temperatures up to 900°C. Its position near the top of the core complex is unlikely to be a simple coincidence. Current models suggesting that core complexes are initiated as the serpentine stability field or the brittle-ductile transition is crossed seems thus not valid for the ICH at 5° South. Therefore, it was our major goal during this cruise, to find this horizon again for an appropriate mapping and sampling, in order to confirm or reject our hypothesis on high-temperatures shearing processes during the formation of this core complex.

Details of operation of dive 310ROV

Thanks to our experienced ROV pilots and their careful pre-dive preparation, we encountered no technical problems and could thus fully focus on the geological work. The ROV track, the locations for sampling and a description of the outcrops are shown in Fig. 2.

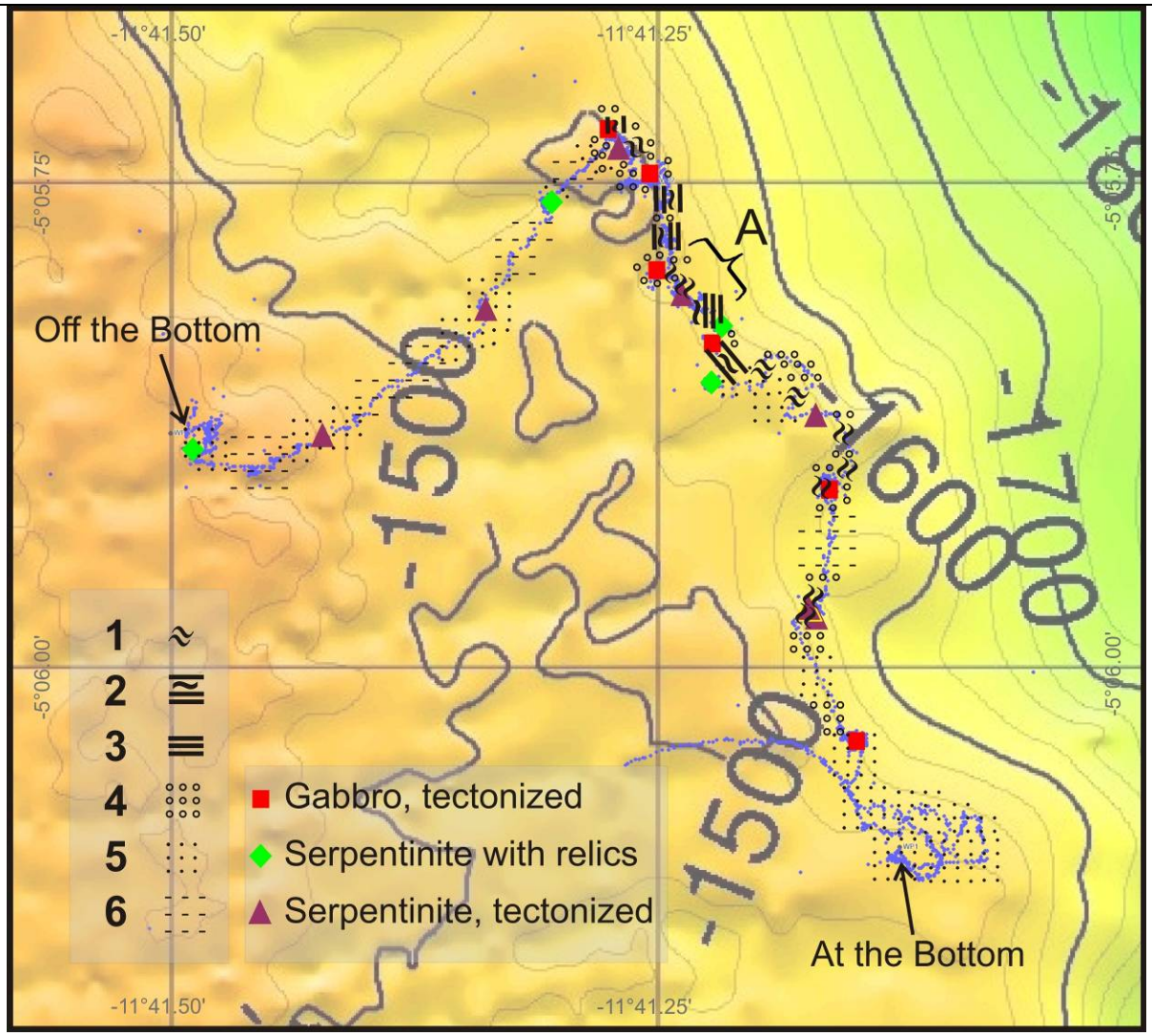


Fig. 2.4.3.2 Detailed map of the area covered by the ROV dive at station ROV310 (based on bathymetric map from Reston et al., 2002) including the ROV track (tiny blue points), description of the outcrops, and location of samples taken. Signatures: 1 – extremely tectonized and sheared zones (thickness: meter- to decameter range); formation of phacoids; 2 - steep cliff consisting of massive gabbro including individual shear zones in the decimeter to meter range; 3 – steep cliff consisting of massive gabbro; 4 – moderately steep slope with m-sized outcrops of massive rocks, talus and sediments; 5 – gently dipping slope with high amount of foraminiferous ooze, boulders, and pebbles; 6 – plateau, highly sedimented with boulders and pebbles; A – series of excellent outcrops from which the schematic profile in Fig. 4 was derived.

The travelled distance during our dive was 2.6 km. We started our dive at that point where we left sea bottom after the ATA_63ROV dive in 2008. We finished our profile at WP3, the highest point of the ICH plateau. We focused our observations mainly on the edge between the rift flank and the plateau and traversed this key horizon several times, in order to identify strongly sheared rocks in the outcrops corresponding to the presence of possible high-temperature shear zones including the mylonite horizon. Our work was hampered by the fact that it is nearly impossible to identify individual lithologies due to thick Mn-oxide-cover on all rocks, an experience we made already during the two ROV dives performed in 2008. But,

in many cases we were able to characterize structural details, as tectonized zones, joints, foliations, and the nature of the contacts between the neighboring lithologies. We collected 17 rock samples, which could be identified after the ROV recovery as ultramafic (11 samples) and mafic (6) in composition.

Thanks to the excellent features of the OFOP-protocol (Ocean Floor Observation Protocol), where all essential dive data like coordinates, depth, heading of the ROV, depth above seafloor, are included, we were able to study in detail the videos recorded by the ROV cameras (~ 17 hours video material in total for this dive) and to characterize the key lithologies at least from those outcrops from which samples were taken. Due to the knowledge of the ROV heading, it was even possible to obtain structural data from the recorded videos.

Results

During traversing the uppermost rift flank to the NW we passed several outcrops where the presence of marked shear zones could be observed, often with the formation of phacoidal bodies (Fig. 4). On the other hand, in the lowermost parts of our dive we observed outcrops of massive walls composed of gabbro, without any sign of deformation (Fig. 4).

Fig. 2.4.3.3 Outcrop images obtained with the still camera. Left: extremely sheared serpentinite sequence near the top of the plateau; from this outcrop, sample 310ROV-2 (tectonized serpentinite) was taken; visible are meter-sized phacoids; Lat -5.0995, Lon -11.6861; ROV heading 287. Right: massive gabbro wall in the deep part of the profile arranged in m-sized layers; perpendicular jointed; not far from this outcrop, rock 310ROV-11 was sampled; in the lower right, initiation of shear zone is observable (white arrow); accordingly the corresponding gabbro sample shows signs of deformation (sheared surface, micro-brecciation, but shows still domains of unstrained gabbro); Lat -5.0960, Lon-11.687, ROV heading 295.

The macroscopic inspection of the 17 samples revealed that all rocks, both the ultramafic and the mafic, are tectonized. Some exhibit a record of strong shearing processes, with the formation of striations of the surface, foliation, and the development of phacoids. Among the samples taken, we identified three groups of rocks (Fig. 2): (1) tectonized gabbros, (2) tectonized serpentinites (no relictic peridotite minerals visible), and (3) serpentinites with relics of primary peridotite minerals. Details of the rock descriptions including photographs of the samples are presented in the Appendix. A key observation is that some of those rocks

characterized as tectonized gabbros are strongly foliated with domains characteristic of amphibolite. These show that fine, dense lamination which is typical for ultramylonite, which we know from our 2008 Atalante 63ROV dive. With the help of the recorded video information, we were able to localize a strongly sheared horizon including the mafic ultramylonites in the uppermost zone of the rift flank related to the last 50 meters below the plateau. At the northern part of our dive along this tectonized horizon we found excellent outcrops where it was possible to establish a schematic profile through the uppermost part of the rift flank, which is presented in Fig. 4.

The profile starts with massive, perpendicular jointed gabbro without record of strain in the lowermost position. This corresponds to the gabbroic core of the ICH complex, from which we recovered more than 20 samples during the Atalante Cruise Leg 2 in 2008. Moving upward, individual shear zones of decimeter to meter thickness within the gabbroic sequence become more and more prominent representing different lithologies: (1) extremely sheared gabbro now forming the finely laminated ultramylonite; (2) strongly tectonized serpentinites, often with the development of phacoids. Moving upward, a changing from mafic to ultramafic lithology can be observed, which is mostly strongly sheared in sub-parallel zones, often forming tectonites of serpentine, without any relics of the primary peridotite stage. Characteristic are blocks in decimeter to meter size with phacoidal shapes. Some meters above this sequence, the plateau starts with foraminiferous ooze and pebbles, blocks, and sometimes boulders of tectonized serpentinite. From this it is implied that the roof of the ICH consists of tectonized peridotites.

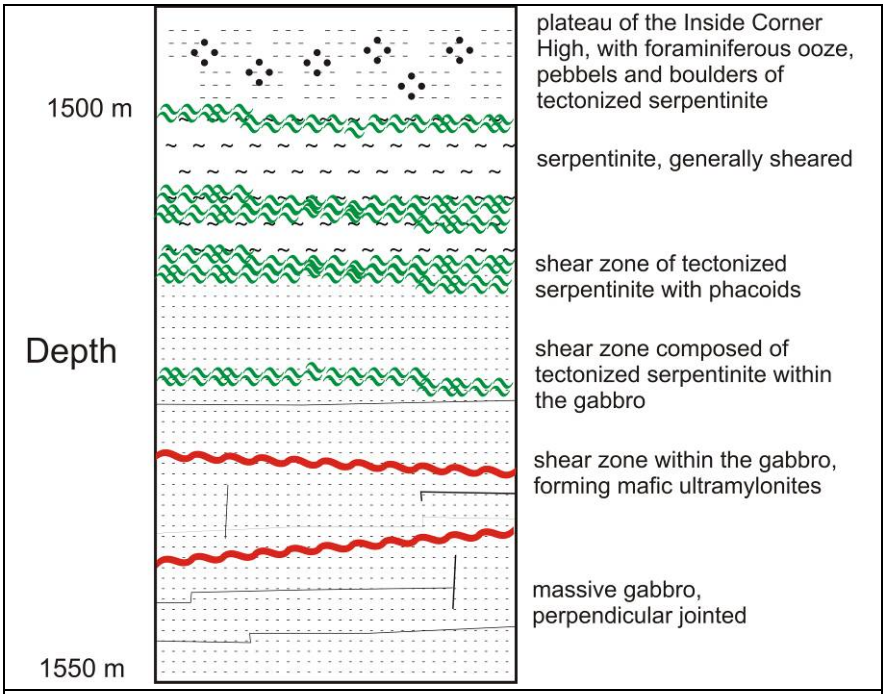


Fig. 2.4.3.4 Schematic profile of the uppermost 50 m of the rift flank of the ICH at 5° South, based on outcrops from location A (see Fig. 2) and corresponding in-situ ROV sampling.

An important result of our ROV work is the successful sampling of several mafic rocks corresponding obviously to ultramylonite, suggesting that high-temperature tectonic processes proceeded during the formation of the ICH complex. Moreover, we found that the occurrence of ultra-mylonites is not a local phenomenon, but that mylonites are present throughout a ~ 50 m thick zone beneath the roof of the complex. Thus, our working hypothesis that "hot" instead of "cold" shearing was important during the tectonic evolution of the ICH at 5° S, seems supported.

2.4.3.4 ROV observations at 5°S

During M78/2, two dives were partly devoted to explore between previously known hydrothermal areas and to investigate the nature of features apparent on the detailed bathymetry previously obtained by the autonomous underwater vehicle (AUV) ABE from Woods Hole Oceanographic Institution (Fig. 5). Dive 297ROV started at Red Lion and showed a cone SE of Red Lion to be of volcanic origin. The dive than followed the eastern boundary of the detailed bathymetric map and documented the occurrence of abundant sheet flows and small areas of pillow lava, the latter mainly near the larger pillow mounds to the east of Red Lion and to the north of Sisters Peak. Additionally, another musselbed between Red Lion and Comfortless Cove was discovered suggesting that the area of diffuse hydrothermal fluid upflow is much larger than previously thought. The location of the Clueless field, discovered during a previous cruise, but without proper navigation, was specified as: 04°48.240'S / 12°22.245'W, placing it to the SE of Sisters Peak. It seems that most diffuse venting takes place in the vicinity of Comfortless Cove, six areas of diffuse flow and associated faunal communities are currently known here, however, the area to the east of the bathymetric map is completely unexplored.

Another dive, 308ROV, was used to map the area between Turtle Pits and Comfortless Cove, and to investigate the nature of three mounds apparent on the ABE bathymetry. These features proved to be of hydrothermal origin. The southernmost mound (04°48.455’S / 12°22.465’W) is larger than any other, presently active, hydrothermal feature in this area and sampling showed it to be constructed of massive sulfides overlain by Fe-oxyhydroxides. Minor diffuse fluid flow is evident in a small crater near the top of the structure. The two smaller mounds are likely also composed of sulfidic material underneath a thick Fe-oxide cover, but, since no samples were taken, visual inspection alone is no proof. The presence of old sulfide mounds and the discovery of additional inactive sulfide structures close to Sisters Peak are evidence for earlier episodes of hydrothermal activity at 5°S. The hydrothermal mounds are situated at a large NW/SE striking fracture and close to the northern extension with the fracture hosting the Turtle Pits site. Although the trace of this fracture in the bathymetric data disappears just north of Turtle Pits, the location of the mounds might imply the continuation of this fault to the north. The location of massive sulfide deposits at intersections of crosscutting faults is well known from ancient deposits and, due to enhanced fluid flow at those crosscutting faults, could also explain the large size of the mounds when compared to the presently active sites.
During the second part of the dive we approached the NNE/SSW striking terrain with numerous collapse features, including basalt pillars and skylights, between Turtle Pits and Comfortless Cove. Here we observed yet another musselbed and additional Fe-oxyhydroxides. It is very likely that even more diffuse vent sites occur all along this collapsed area connecting the Widewake field in the south with those diffuse sites at Comfortless Cove. This suggestion is confirmed by the finding of another musselbed just south of Sisters Peak. There is still a large potential for additional hydrothermal vent sites in this area, since no exploration north of Red Lion, south of Turtle Pits, or east of Sisters Peak has been undertaken.

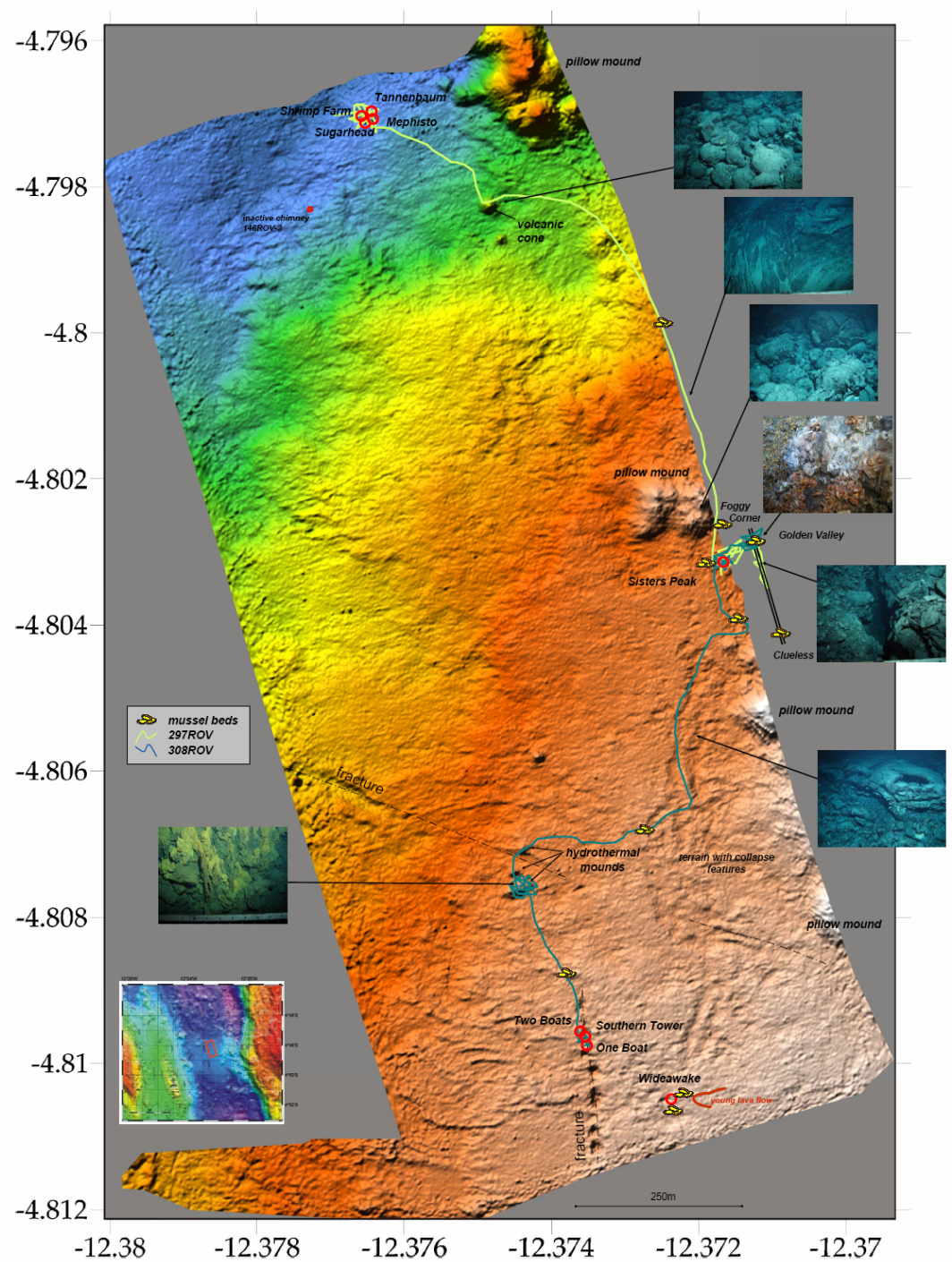


Fig. 2.4.3.5: ROV-tracks (stations 297ROV and 308ROV) posted on top of the existing AUV ABE (source C. German, WHOI) bathymetry. The original data has been reprocessed to provide more detailed information. Included are still images of selected geological features observed during this cruise. Three large hydrothermal mounds have been observed to the north of Turtle pits as well as several new mussel beds in the vicinity of the Comfortless Cove area. Note that no exploration north of Red Lion, south of Turtle Pits, or east of Sisters Peak has been undertaken leaving a large potential for additional hydrothermal sites in this area.

2.4.3.5 ROV observations at Lilliput

Four ROV dives took place in the Lilliput area. While sampling of diffuse fluids and mussels were the major activity at this site, exploration and geological mapping has been possible on several dives showing a distinct difference between the eastern parts of the area hosting the hydrothermally active sites and the western part mainly characterized by intensive fissuring

and pillow lava severely effecting the pillow mounds. This is clearly visible in the bathymetric map provided by the AUV Abyss during this cruise (Fig. 6). In the eastern part volcanic edifices are still intact and show only narrow fissures and cracks. The first dive, 319ROV, stayed in the eastern part, came down in to the west of the Main Lilliput site and crossed a NS fissure with some Fe-staining, before heading towards the mussel beds of Main Lilliput. During the dive two seamounts east of Main Lilliput were visited (09°32.72'S / 13°12.48'W and 09°32.94'S / 13°12.42'W; Fig. 6) that consists of pillow lava, that show intense fissuring in several crosscutting directions (star-like) resulting in block rotation and talus formation. While most fractures in the area run at 350° the seamounts to the east show also E/W and NW/SE trending fissures. The fractures can be several meters wide and expose massive flows; drainback is not visible. Additionally the large low lying mound to the northwest of Main Lilliput was investigated and was shown to consist of pillow lava cut by several small fissures. Selected images from the various lithologies are given in Fig. 7.

Dive 324ROV investigated the western fault block during the first part of the dive and showed that this area consists of intensely fractured and fissured pillow mounds. Individual fractures here are wider (Fig. 8) and show a higher throw when compared to those in the eastern part. Interestingly, this entire area does not show evidence for recent low-temperature venting implying that the fracture system and the volcanic edifices are older than those in the east. This is in agreement with the strong displacement of the volcanic edifices by the various faults in the area. The second part of the dive was devoted to the hydrothermally active part in the east where several areas of low-temperature Fe-oxyhydroxides were found in the Limtoc area and towards Main Lilliput. Collapse features including skylights, lava pillars, and collapsed roofs are abundant in this area. The final part of the dive was placed to the northeast of Main Lilliput passing by east of Candelabrum Meadows. Here a previously unknown site of tiny mussels was discovered. Close to finishing off the dive we passed the fissured terrain again in the very north of study area. The presence of Fe-oxyhydroxides in interstices of pillows indicates the potential for further hydrothermal activity to the north.

The next dive, station 329ROV, was dedicated to sampling at Main Lilliput before investigating the area of the Eh anomaly, located well outside the Main Lilliput area, found during previous CTD and AUV stations. During this dive sedimented pillow mounds, lobate flows and massive tilted blocks of basalt have been observed, that are very similar to those documented in the Lilliput area, however, the thick sediment cover indicates that the entire area is old and, since no evidence for low-temperature venting or Fe-oxyhydroxide formation has been found, is also hydrothermally inactive. The Eh-anomaly does not appear to be related to hydrothermal activity.

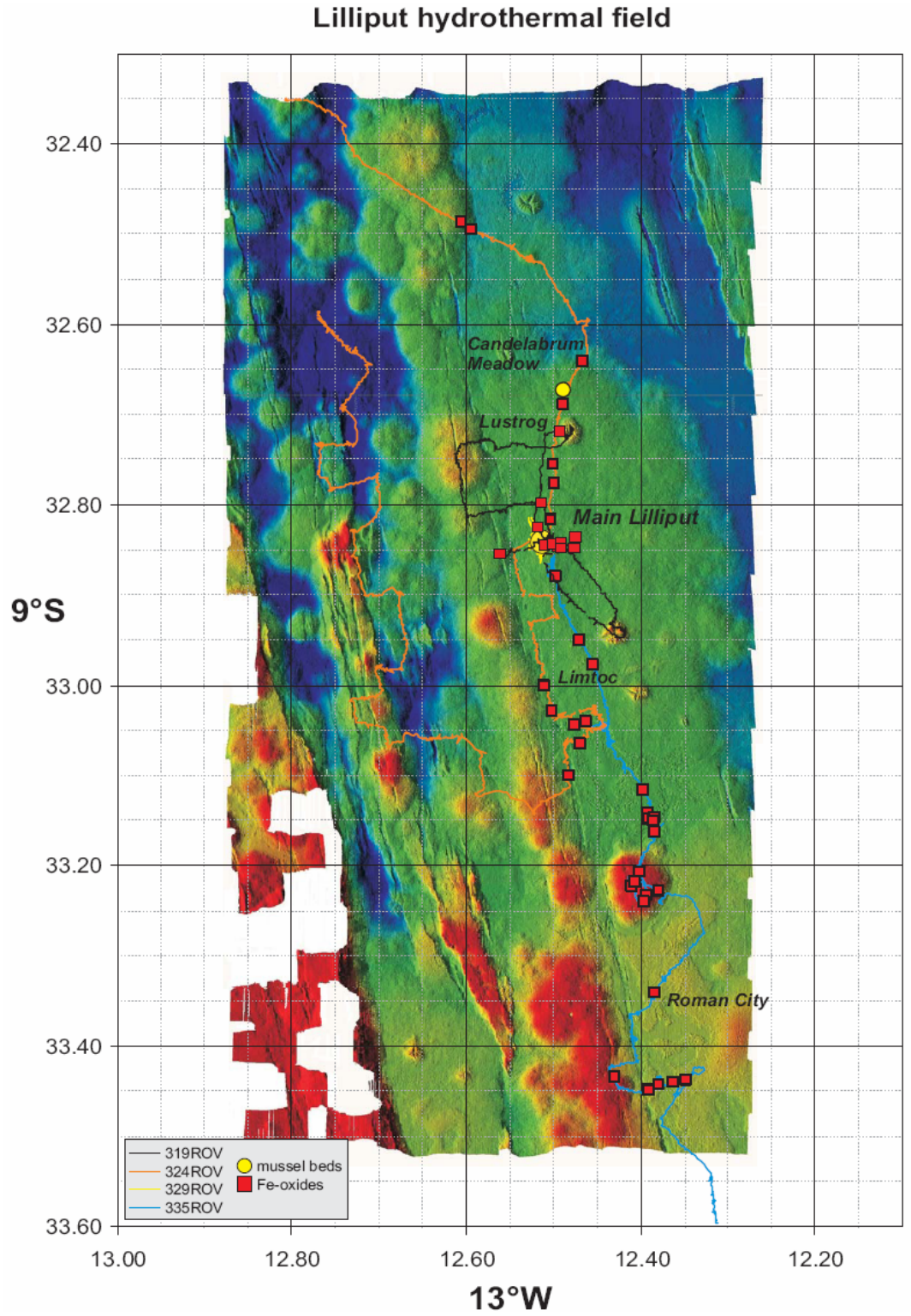


Fig. 2.4.3.6: Bathymetric map obtained by AUV ABYSS during this cruise overlain by edited ROV-tracks. The ROV positions („Posidonia“) obtained during the cruise showed various offsets to the map and have been edited to fit to the geological observations. The red squares denote the presence of Fe-oxyhydroxides indicating widespread venting of low-temperature hydrothermal fluids, mainly along younger fissures to the east of the central volcanic chain.

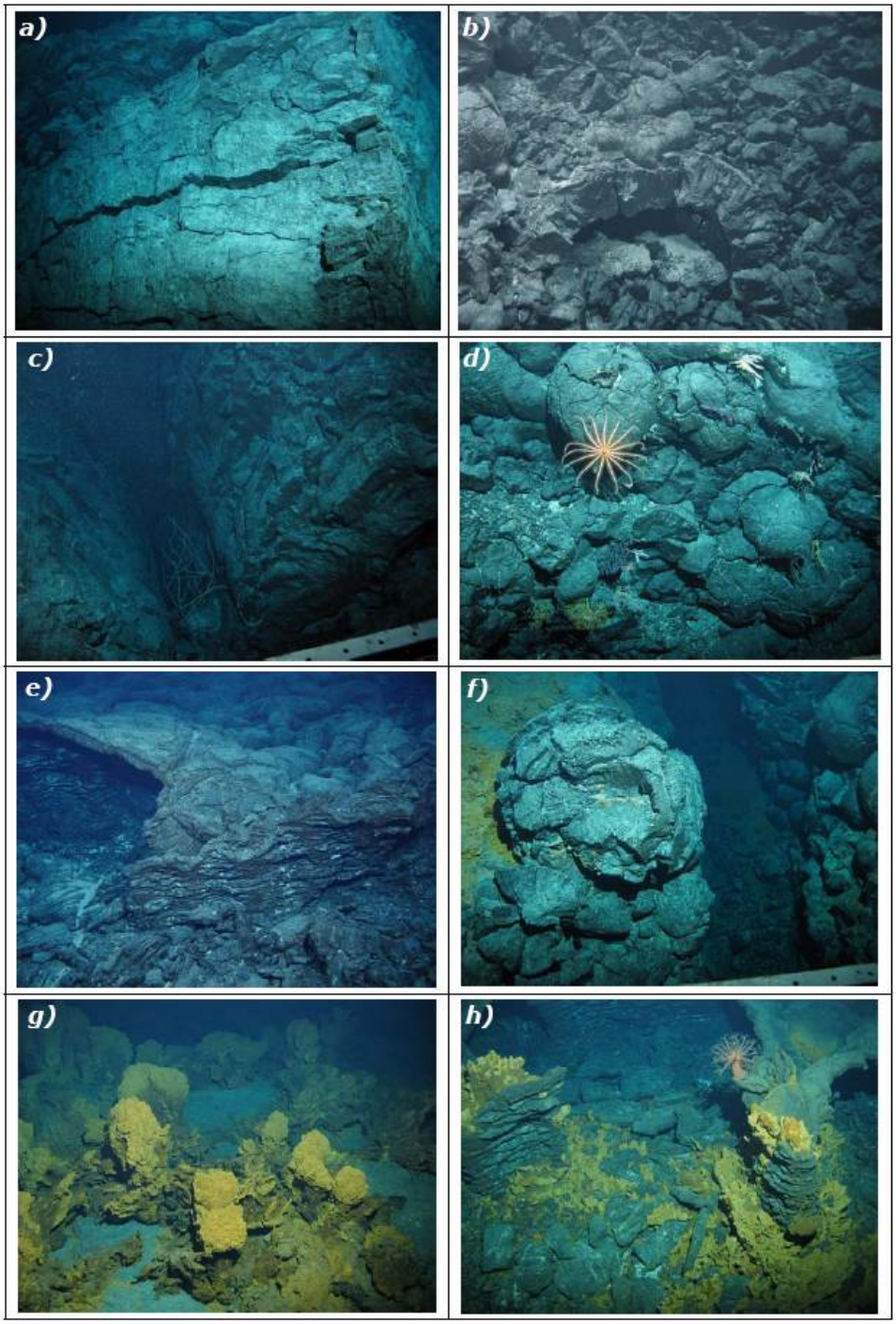


Fig. 2.4.3.7: Images of geological lithologies in the Lilliput hydrothermal field. a) massive rotated basalt block exposed by faulting at the top of a small seamount SE of Main Lilliput. b) Vertical section through a pillow mound exposed on a wall in the western fault block. c) E/W trending fissure in an elongated pillow mound at the northern limit of the mapped region. d) pillow lava and fauna exposed on an old pillow mound to the west of Main Lilliput (western fault block). e) Collapse features within lobate flows near Roman City. f) Fissure cutting pillow mound with associated Fe-oxyhydroxides along the fissure rim. g) Fe-oxyhydroxide chineys developed on top of lobate flows between Limtoc and Roman City. h) Fe-oxyhydroxides covering basalt pillars at Roman City.

The last dive, 335ROV started at Main Lilliput and investigated the area to the south, passing Limtoc and Roman City before exploring new ground further to the south, an area not covered by the AUV map. The discovery of Fe-oxyhydroxides outside the AUV map provides ample evidence for further hydrothermal activity in unexplored regions, albeit being less abundant

when compared to the Main Lilliput area. Interesting is the abundance of Fe-oxyhydroxides on a large seamount between Limtoc and Roman City.

In summary, it seems noteworthy that the occurrence of Fe-oxyhydroxides is limited to the eastern part of the working area and related to both, a recent, north/south trending fissure system and the tops of some younger pillow mounds. Especially the older mounds of the western fault block and to the east of Main Lilliput do not show evidence for recent hydrothermal activity. Additionally, drainback features only occur in the eastern part and seem to be an integral part of the geological setting of venting in this area. The discovery of Fe-oxyhydroxides well to the north and south of the previously known areas documents the potential of additional vent sites at Lilliput, that should be explored. During this and earlier cruises, no evidence was found of oxidizing massive sulfides suggesting that all Fe-oxyhydroxides are formed by upwelling „warm“ fluids (<< 100°C) that lost H_2S and metals in the subseafloor. The abundance of collapse features in the area of main Fe-oxyhydroxide occurrence could, if persistent at depth, potentially provide the porous substrate in which ascending high-temperature fluids are trapped underground only releasing cooler fluids to the seafloor.

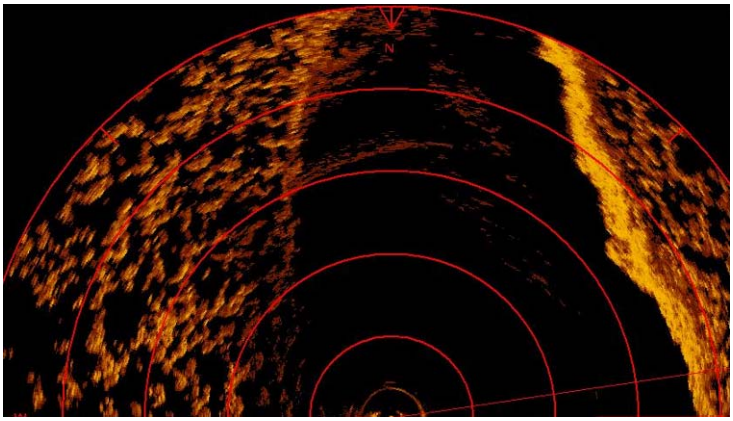


Fig. 2.4.3.8: Sonar image, looking south, showing the width (25 m) of one of the larger fissures in the western fault block while the ROV is hovering in the center of the fissure. Distance between red lines in this image is 5 m with a total range of 25 m. Note that individual pillows are visible in the left (eastern) part of the image and that the fissure is narrowing quickly towards the south. Dive 324ROV.

2.4.4 Physical Oceanography

(Christian Mertens, Janna Köhler)

The spreading of hydrothermal products into the deep ocean is controlled by background currents, tides, internal waves and turbulent diffusion. During METEOR cruise M78/2, near field measurements of temperature, salinity, turbidity, and velocity at the Turtle Pits and Lilliput hydrothermal sites were made to study the plume dispersal. Additionally, water samples were taken for later helium isotope analysis. A hydrothermal plume in the local background stratification should reveal itself by negative anomalies in temperature and salinity as well as an increase in turbidity and drop of oxygen reduction potential. In addition to plume mapping, the temperature and density field, as well as the vertical shear of the horizontal velocity field, will be analyzed to determine the strength and distribution of turbulent vertical mixing in the water column above the Mid-Atlantic ridge.

Conductivity-temperature-depth (CTD) casts were carried out using a Sea-Bird Electronics, Inc. SBE 911plus system that was equipped with a custom build Seapoint Turbidity Meter (5x normal gain). The underwater unit was attached to a SBE 32 carousel water sampler with 24 Niskin bottles. Two bottles were left out for a lowered acoustic Doppler current profiler system (LADCP), hence a maximum of 22 bottles was used. The complete system worked properly throughout the cruise, except for bad turbidity data on stations 282 and 327 caused by a stained sensor. Salinity samples, typically three on each cast, were collected for later analysis at home. In total 23 CTD casts were carried out, including three towed transects (tow-yo) at Lilliput (Fig. 2.4.4.1).

Two RD Instruments 300 kHz Workhorse Monitor ADCPs, were used for velocity

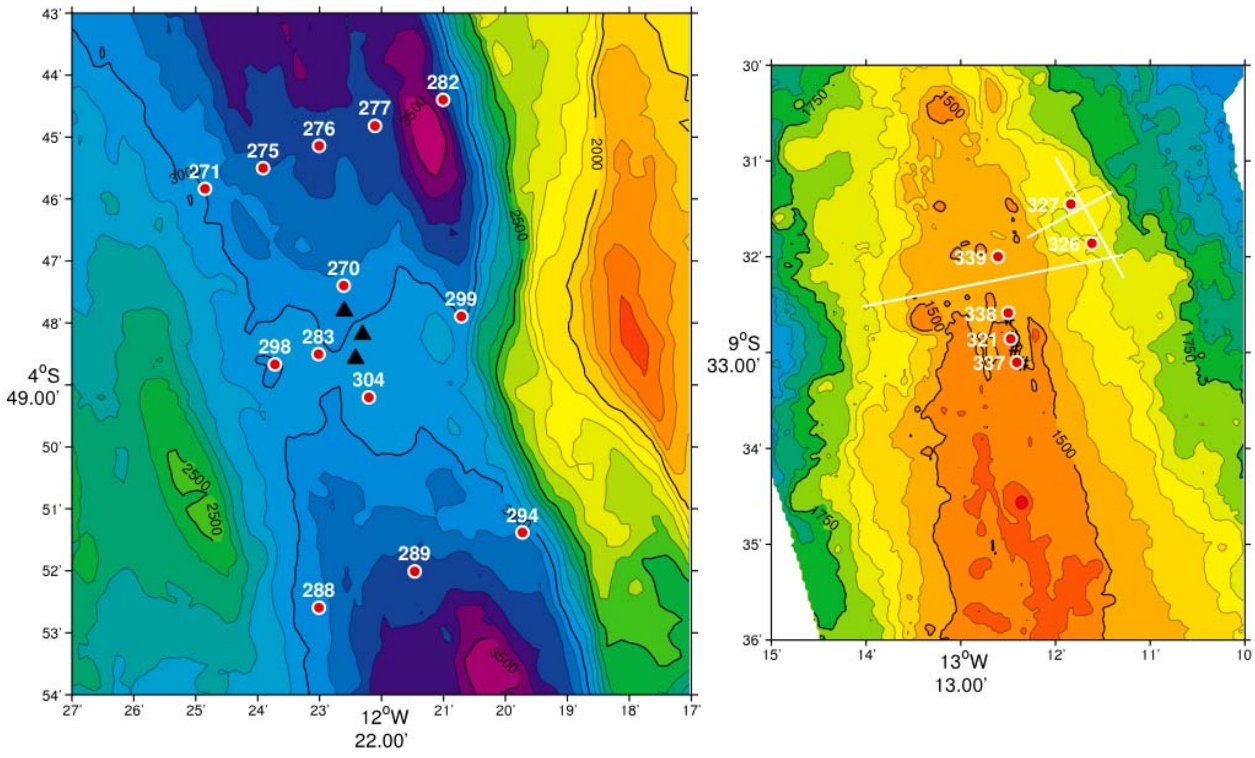


Fig. 2.4.4.1: Maps of the working areas at Turtle Pits (left) and Lilliput (right) showing the CTD/LADCP stations (dots). White lines denote the tow-yo tracks in the Lilliput area.

profiling. The instruments worked in a synchronized master-and-slave setup, where the downward looking master (S/N 7915) triggers the upward looking slave (S/N 2161). The instruments were powered by an external battery supply, that consists of 35 commercial quality 1.5 V batteries assembled in a pressure resistant Aanderaa housing.

An inverse method incorporating the bottom track velocities was used for the post processing of the raw data. The overall performance of the two instruments was very good: The range of each instrument was typically 150 m in the upper parts of the water column and 60 to 70 m at depths exceeding 1500 m. Thus, the total range of the package varied from 150 to 300 m. With lowering and heaving velocities of 1 m/s, this range amounts to 100-200 estimates of current shear in each depth cell in the deep water, and more in the shallow layers, depending on the abundance of backscatterers.

To collect redox potential (Eh) data, a miniature autonomous plume recorder (MAPR, E. Baker, NOAA, PMEL) was attached to the CTD on eight of the stations. MAPRs are self-contained instruments, that record data at pre-set time intervals (5 seconds) from temperature (thermistor mounted in a titanium probe, resolution 0.001°C), pressure (0-6000 psi gauge sensor, resolution 0.2 psi), and nephelometer (Sea Tech Light Backscatter Sensor) sensors. The Eh probe was build by K. Nakamura (AIST, Japan). Only one MAPR (S/N 41) was used on this cruise, that worked properly except for occasional hang-ups during data recovery.

For measurements of the helium concentrations and isotopic signature, water samples were collected from the Niskin bottles. In total 237 samples were taken, 181 of them at stations around the Turtle Pits vent sites and the remaining 56 at Lilliput. The samples were sealed free of head space and gas tight in copper tubes (sample volume 40 ml). Helium isotope measurements will be carried at the University of Bremen with a fully automated UHV mass spectrometric system. The sample preparation includes gas extraction in a controlled high vacuum system. Helium and neon are separated from permanent gases in a cryo system at a temperature of 25 K. A split of the sample is analyzed for 4He, 20Ne and 22Ne with a quadrupole mass spectrometer. At 14 K He is separated from Ne and released into the sector field mass spectrometer for analysis of 3He and 4He. The facility achieves about ±0.2% precision for 3He/4He ratios, and ±0.5% or better for helium and neon concentrations. The primordial components of helium isotopes are ideal tracers for large-scale distribution of vent fluids in the water column. Samples collected during this cruise are supposed to provide the regional distribution of dispersing vent fluids in the water column leading to an estimate of its volume.

Attempts were made to collect helium samples directly at the vents with the ROV. Special tools, that prevent phase separation of vent fluids and gases, were developed for the sampling of vent fluid. However, despite the positive experiences on previous cruises were several samples were successfully collected, the helium sampling with the ROV on this cruise was an utter failure. The first attempt was to collect a helium sample was made von April 18 (station 281) at the black smoker One Boat of the Turtle Pits vent field. A newly developed sampler was used, that was intended to reduce handling difficulties and sampling time compared to the old sampler. The idea of the new design was that only one trigger has to be pushed to close the sampler instead of closing the two valves at the upper and lower end of the sampler manually. However the mechanism did not work thus leaving the sampler open, although it

appeared in the camera that the trigger was pushed several times. However, during ascend the sampler slipped out of the Rigmaster and was lost. The second attempt was made on April 21 (station 297), using the old type of sampler. The sampling site was the smoker Mephisto of the Red Lion vent field. The sampling went well, although it took about one hour to take the sample. Unfortunately one of the valves was opened again during stowing, which made the sample unusable. Further attempts to collect helium samples with the ROV were not scheduled.

During a L'ATALANTE cruise in January 2008 a mooring, with CTD and acoustic current meter profiling along the wire (IFM-GEOMAR), was deployed half way between Turtle Pits and Red Lion (4° 48.20'S, 12° 22.51'W). Messages from its Argos watchdog were received in July 2008, indicating a loss of at least the top-most floatation. Several tries from different directions were made to locate the releases acoustically, but even with all other acoustic equipment of the ship switched off not a single response was received. Nevertheless release commands were send on April 23, 2009 at 07:20 UTC but as no signs of the mooring were spotted after one hour of lookout it has to be concluded that the mooring is completely lost. However, this was already the second mooring lost in this area. The first mooring with three Aanderaa RCM11 current meters (Univ. Bremen) was deployed on METEOR cruise 68/1 in May 2006, and could not be recovered during the L'ATALANTE cruise in January 2008, but it was possible to locate the releases acoustically on the sea floor. This location was confirmed on the present cruise, which indicates the proper functioning of the acoustic equipment.

Two hydrographic sections were made at Turtle Pits, one north (five stations, Fig. 2.4.4.2) and one south (three stations) of the vents. The local bathymetry is closed to the sides below a depth of 2800 m, which coincides with the upper boundary of the hydrothermal plume. Hence

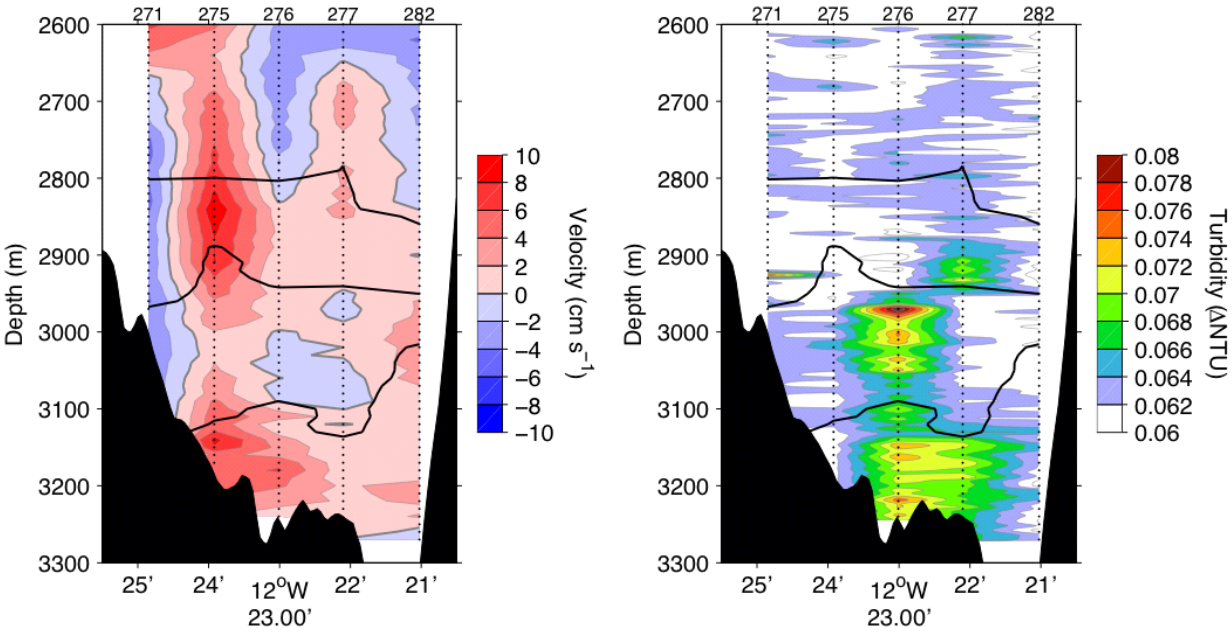


Fig. 2.4.4.2: Current velocity (left) and turbidity (right) along a cross-valley section north of the Turtle Pits vent sites. Thick black lines denote density surfaces that separate the different plume layers (σ_3 = 41.465, 41.468, and 41.471 kg m^{-3}).

the two sections form a closed box where measurements of the current field and the

stratification allow to calculate fluxes of volume, heat and helium into and out of the vent field area.

The area is dominated by along-valley northward currents, which are modulated in strength by tides. The average current velocity below a density of σ_3=41.465 kg m^{-3} (that coincides roughly with the upper boundary of the side wall) was 1.7 cm/s, but maxima exceeded 15 cm/s (Fig. 2.4.4.3). The strongest currents are orientated northward, while southward currents are weaker and occur only in the effluent plume layer. The volume transport associated with

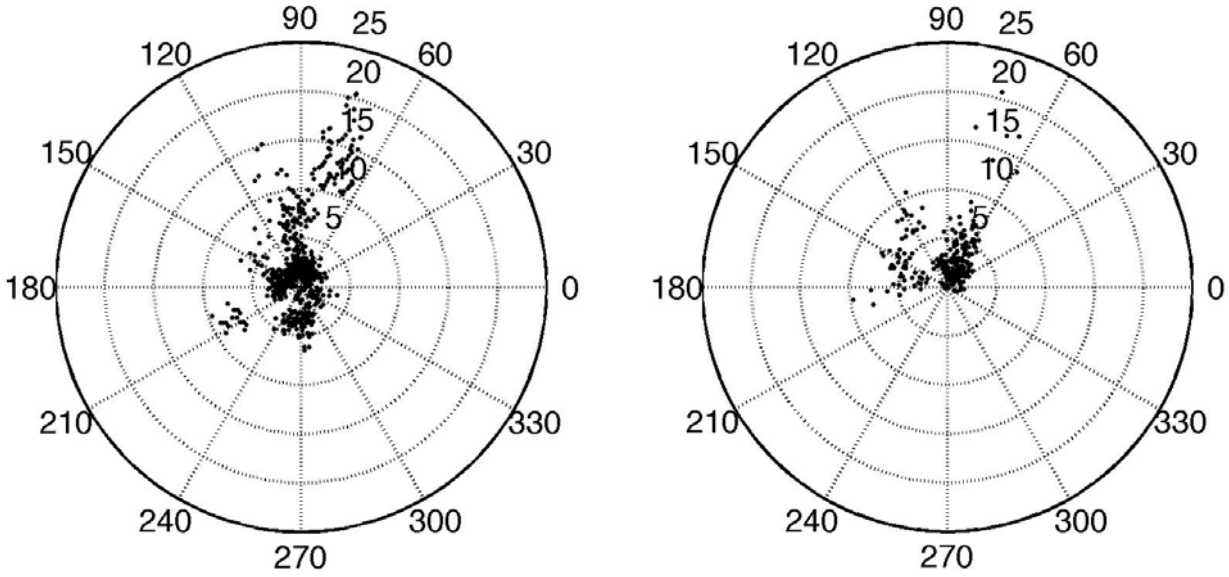


Fig. 2.4.4.3: Scatter plot of amplitude and direction of the currents from all stations in the Turtle Pits area in two different density layers. The density range of the upper layer (left hand side, σ_3=41.465-41.471 kg m^{-3}) corresponds to the effluent plume layer, and velocities below σ_3=41.471 kg m^{-3} are shown in the right hand side panel. Most of the data points in both layers have a northward component, i.e. fall into the E-N-W segment of the diagram (N=90°). The amplitude of these currents (distance from the centre of the plot) ranges from a few centimeters per second to more than 15 cm s^{-1}.

the flow amounts to 0.021 Sv (10^6 m^3 s^{-1}) across the section north of the vent sites, 0.011 Sv of the total volume transport were observed in the effluent layer.

The distribution of turbidity along the northern section exhibits three distinct layers with local maxima backscatter signal within each of them. The top-most layer (σ_3=41.465-41.468 kg m^{-3}) shows maximum backscatter at station 277 in a depth of about 2900 m. The source of the signals in this layer are presumably the vents at Turtle Pits and Comfortless Cove. The maximum plume signal of the intermediate layer (σ_3=41.468-41.471 kg m^{-3}) was located at station 276, thus westward of the maximum in the upper layer. In the bottom layer (σ_3≥41.471 kg m^{-3}) the turbidity is still high, but less focused and maximum signals were found at stations 276 and 277. Although about 300 m below the depth of the hydrothermal vents, there is virtually no density contrast between the bottom layer at the vents and the northern section, hydrothermal signals in the bottom layer may therefore, at least partially, also originate from diffuse venting.

Further CTD stations were made in the vicinity of the vent sites itself, two of them are shown in Fig. 2.4.4.4 (stations 283 and 304). Station 283, east of Turtle Pits, shows a strong

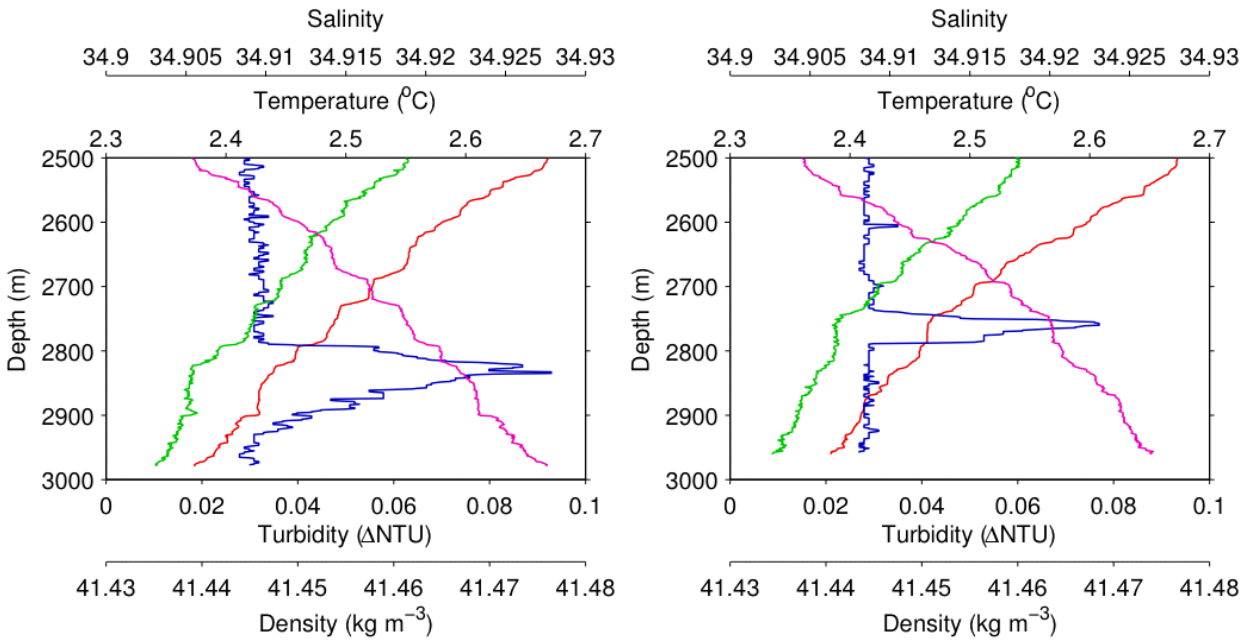


Fig. 2.4.4.4: Vertical profiles of temperature (°C, red), salinity (green), turbidity (blue), and density anomaly (σ_3, kg m^{-3}, magenta) at two CTD stations near the Turtle Pits hydrothermal field. Station 283 (left hand side) was located east and station 304 (right hand side) was located south of the vents.

turbidity signal between 2800 and 2900 m and at station 304, in the south, a slightly weaker signal was found between 2750 and 2800 m. Although it appears likely that the plume signals found at these two stations originate from the known vents of Turtle Pits, this is not supported by the direction of the observed currents, that point to the opposite direction. Thus it cannot be ruled out that these signals originate from a different, yet unknown, source. Similar spurious signals had been found on previous cruises, but a detailed AUV survey would have been necessary to clarify the situation.

In contrast to Turtle Pits and Nibelungen, the Lilliput hydrothermal site (9° 33' S) is quite shallow (about 1500 m), which makes plume anomalies in the water column difficult to observe. Hydrothermal fluids in shallower areas have lower maximum temperatures and lower metal contents and hence often carry only a weak or no turbidity signal. Further, the background variability of temperature is high in this depth range because it is situated between the shallow Antarctic Intermediate Water and the upper North Atlantic Deep Water as well as subject to strong mixing above the Mid-Atlantic Ridge. The hydrographic work at this site was therefore restricted to four CTD casts in the vicinity of the known diffuse venting locations of Lilliput. Two additional CTD casts (stations 326 and 327) and two tow-yo tracks were made northwest of Lilliput in search of a possible new vent location. The largest turbidity signals were found on stations 327 and 339 (Fig. 2.4.4.5) and during a ridge-crossing tow-yo north of Lilliput (Fig. 2.4.4.6). The turbidity and redox potential signals found on the stations close to Lilliput were small and decreased southward. Thus it is not clear wether they originate from the diffuse venting at Lilliput or from an other source north of Lilliput were the strongest signals were found. Motivated by relatively strong Eh signals on the eastern flank of the ridge, that were found on the ridge-crossing tow-yo (Fig. 2.4.4.6), a search for new vent

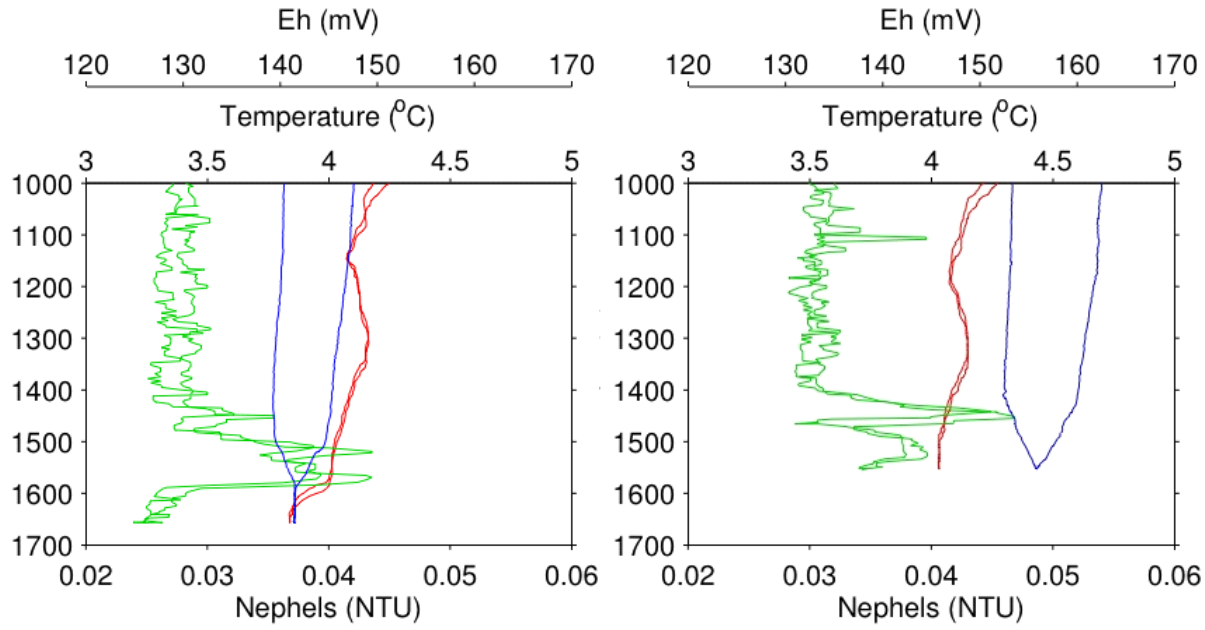


Fig. 2.4.4.5: Vertical MAPR profiles of temperature (°C, red), turbidity (green), and redox potential (mV, blue) at two stations near the Lilliput hydrothermal field. Station 327 (left hand side) was located northeastward of Lilliput and was carried out in search of a possible new vent location and station 339 (right hand side) was located north of the known Lilliput field.

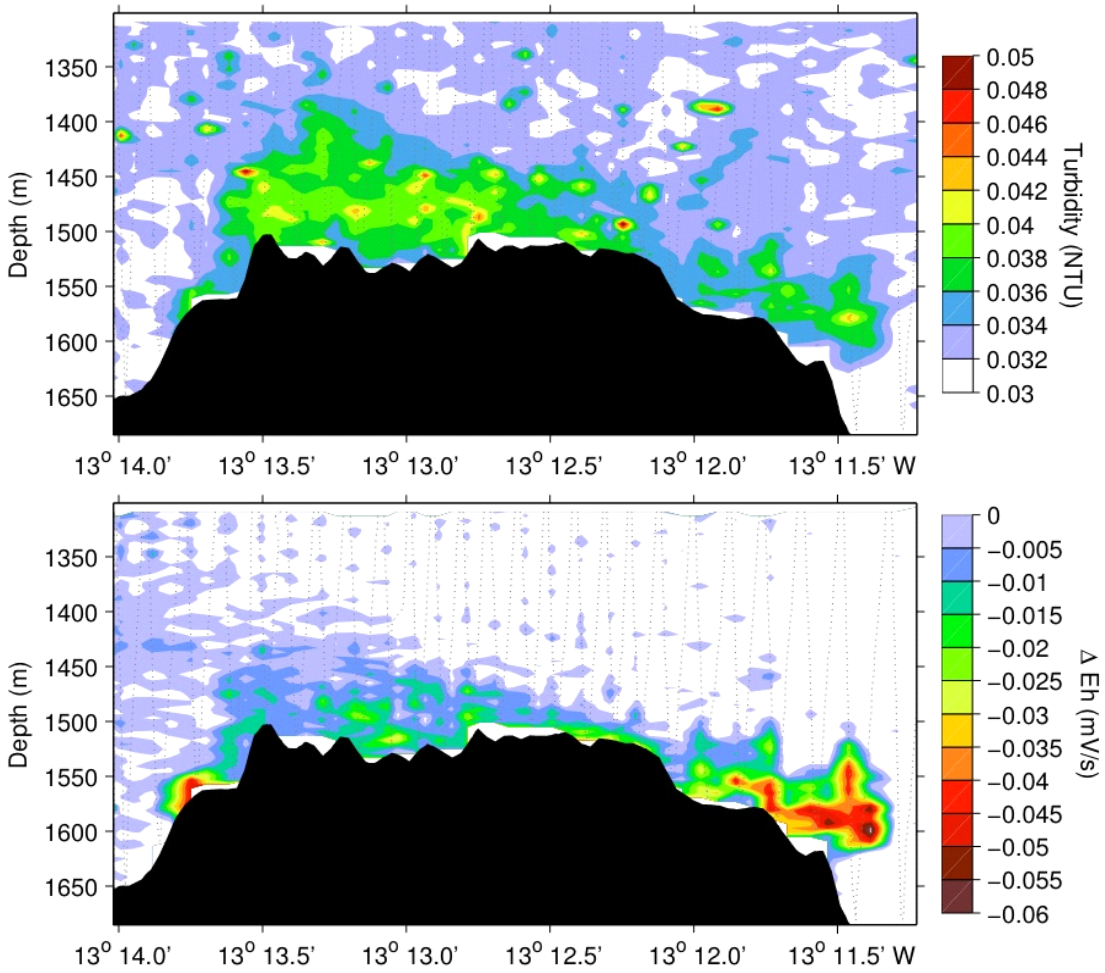


Fig. 2.4.4.6: Horizontal distribution of turbidity (upper panel) and the rate of change of redox potential (lower panel) along a tow-yo track north of the Lilliput field (cf. Fig. 2.4.4.1).

sites was conducted near a shallow mound northwestward of Lilliput. But despite the two further tow-yos and two AUV surveys that confirmed the turbidity and Eh signals of the tow-yos, no vent site could be found during a ROV dive. The source of the signals thus remains unclear, but it may however have been caused by re-suspension of sediments.

2.4.5 Fluid Chemistry

(D. Garbe-Schönberg, V. Klevenz, D. Meißner, H. Strauss, C. Breuer)

Scientific objectives for the fluid geochemistry group were (i) to continue the monitoring of temporal variability of elemental and isotopic compositions in hydrothermal fluids at the southern Mid-Atlantic Ridge, in particular at the vent sites at 4°48'S: Turtle Pits and Red Lion (started in 2005), Sisters Peak (started in 2006), and Clueless (started in 2008); at 8°55'S with Drachenschlund (data from 2006); and at the Lilliput area at 9°33'S (started in 2005); (ii) to identify spatial heterogeneity between different hot fluid vent sites, and (iii) to determine temporal and spatial variability within individual mussel fields. From these long-term observations a quantitative understanding of temporal and spatial variations in fluid chemistry at the slow spreading Mid-Atlantic Ridge will be developed. It is anticipated that the resulting model will be in strong contrast to our current understanding of respective processes that is based largely on results from the East Pacific Rise.

Fluid sampling of both diffuse warm, and focused hot fluids was achieved using the ROV-based fluid sampling system "KIPS" (Kiel Pumping System, KIPS-3). Compared to previous cruises, the design of the KIPS system has been significantly modified with the objective to (1) improve the tightness of sample containers and avoid gas-induced leakage of samples causing cross-contamination of gases; (2) develop a more compact, self-contained unit which can easily be mounted and dismounted on the ROV tool sled; (3) use a deep sea peristaltic pump for *in situ*-fixation by adding reagents into a sample container; (4) use a combination of different temperature sensor technologies to improve accuracy of temperature data. The new KIPS fluid sampling system was successfully used during the entire cruise. A more detailed description of the system components is given in the Appendix. In addition to the KIPS, two titanium syringes ("Majors" after von Damm et al., 1985; manufactured by IFREMER/ BREST-MECA) were used to collect hot hydrothermal fluids (see Appendix for details).

On-board measurements comprised pH, concentrations of oxygen, sulfide, Mg, as well as Cu, Zn in diffuse fluids. Analyses were performed in order to ascertain the quality of sampled hydrothermal fluids (i.e., the degree of admixed seawater) and to provide an initial characterization of fluid composition. Details of on-board sub-sampling and sample preparation as well as analytical methods used are summarized in the Appendix.

2.4.5.1 Chemistry of hydrothermal fluids

Twenty-four hot fluid samples were collected at four locations, and first results are being presented in the following paragraphs.

Turtle Pits – One Boat. Two fluid samples of the black smoker chimney "One Boat" were collected during station 281 ROV with titanium syringes. Fluid was blackened by sulphide particles, indicating a certain degree of seawater entrainment. Ex-situ measurements yielded pH values of 2.44 and 2.62. The Mg concentration indicates a fluid proportion of 74 and 63%, respectively (Tab. 2.4.5.1). Sulphide concentrations of 4.3 and 3.1mM were measured for both samples.

Red Lion – Mephisto. Fluid from "Mephisto", a black smoker at the Red Lion vent area, was sampled during station 297 ROV using the KIPS. Due to an unstable sampling position of the nozzle (see Fig 2.4.4-2 in the Appendix depicting a variable fluid sampling temperature) entrainment of seawater during sampling was relatively high, resulting in precipitation of "black smoke" particles. A broad range of Mg concentrations in the six samples indicates variable fluid proportions between 6 and 80%. Ex-situ pH values ranged from 3.8 to 7.3. Dissolved sulphide concentrations ranging from 1.1 to 4.7mM were determined.

Comfortless Cove – Sisters Peak. The ultra-high temperature fluids of the black smoker chimney "Sisters Peak" were sampled during station 302 ROV using a titanium syringe and during station 308 ROV with KIPS. Sample 302 ROV-1 was of poor quality having a fluid proportion of only 8%. The respective pH is 6.7. The 308 ROV samples have fluid percentages between 29 and 70% and pH values ranging from 2.4 to 4.2. The hot vent fluids from Sisters Peak showed dissolved sulphide concentrations between 2.8 and 7.2mM.

Nibelungen – Drachenschlund. Hot hydrothermal fluid with a constant temperature of 371.6 °C venting from an orifice directly on the seafloor was sampled during station 314 ROV. At this site, sampling was most successful yielding samples with the highest fluid proportions (up to 87%) of all sites. For three of the 9 samples, however, the objective was to sample fluids from the mixing zone between pure fluid and seawater at temperatures around 100 °C for subsequent gene expression studies. Consequently, samples have relative low proportions of 16 – 20% hydrothermal fluid. In the samples with high fluid percentages the pH was measured at values ranging from 2.9 to 3.3 and in the low-fluid samples from 5.3 to 5.8. Sulphide concentration of 0.5 – 1.1mM were measured for hot fluids emanating from the Drachenschlund.

A total of forty-six diffuse vent fluid samples were collected, with twenty-one from different sites at Comfortless Cove and twenty-five at the Main Lilliput vent field. First results are being presented in the following paragraphs.

Comfortless Cove – Foggy Corner. At the diffuse venting site "Foggy Corner" three KIPS bottles and one Niskin bottle were taken during station 267 ROV and one Niskin bottle was taken at station 287 ROV. Acidity was determined to pH values between 7.7 and 7.9 and Mg concentrations indicate fluid proportions between 0 and 4.6 %. Dissolved sulphide concentrations between 0.5 and 1.5µM were measured for three diffuse fluids at Foggy Corner.

Comfortless Cove – Clueless/Desperate. At the diffuse vent site "Clueless" KIPS was used for sampling during station 302 ROV. Fluid percentages were higher than at Foggy Corner with values between 4.6 and 7.4 %. pH values ranged from 6.1 to 6.6. At the vent site "Desperate" KIPS samples were taken during station 287 ROV, with fluid percentages ranging from 0.9 to 4.3%. pH values were determined at 6.7 to 7.4. Thirteen samples of diffuse fluids emanating from different sites at the Clueless mussel fields yielded concentration for dissolved sulphide between 237 and 266µM (Clueless) and 0.6 and 22.3µM (Desperate). In-situ fixation of dissolved sulphide at the Clueless site yielded a concentration of 313.0µM. In two of the Clueless fluids Zn was measured at concentrations of 87 and 254 nM and Cu at concentrations of 13 and 27 nM, respectively. Two other samples from the

Desperate mussel field displayed Zn concentrations at 62 and 41 nM and Cu concentrations of 22 and 28 nM, respectively. These values – as the following ones for other diffuse sites - are only slightly elevated in comparison to seawater concentrations which is caused by the non-conservative behaviour of these metals during mixing with seawater (precipitation of minerals).

Comfortless Cove – Sisters Peak. Fluids were sampled at a diffuse site close to the black smoker Sisters Peak during station 302 ROV. For these, pH values between 6.5 and 6.7 were measured and fluid percentages were determined at 6.1 to 8.3%. Concentration of dissolved sulphide ranges from 69 to 107µM for diffuse fluids at Sisters Peak. One of these samples was analysed for Zn and Cu yielding 85 and 20 nM, respectively.

Lilliput – Main site. The Main site of Lilliput was sampled four times during stations 319, 324, 329 and 335 ROV. pH values for these samples ranged from 5.99 to 6.58, and fluid proportions from 0 to 7.1%. Repeated sampling of diffuse fluids from the Main Lilliput site at the Lilliput mussel fields (25 samples in total) yielded sulphide concentrations ranging from 22-53µM. For two in-situ fixations dissolved sulphide concentrations of 49 and 74µM were measured.

Four of these samples were analysed for Zn and Cu with concentrations ranging from 91 to 431 nM and 19 to 39 nM, respectively.

Table 2.4.5.1: Results from on-board chemical analyses (not endmember corrected)

Stat. No.	Description	Sample ID	Bottle	Date	T (C)	pH	O_2 (µM)	H_2S (µM)	Mg (mM)	Mg (mM)¤	% EM Fluid	Zn (nM)	Cu (nM)
267 ROV	Foggy Corner	1	A2	16.04.2009	3.0-3.5		252						
		2	A3		3.0-3.5	7,9		1,4	51,6	54,3	-0,6		
		3	B4		3.0-3.6	7,9	228	0,5	51,5	54,4	-0,7		
		4	Niskin			7,7	209	1,5	52,2	54,9	-1,7		
281 ROV	Turtle Pits, One Boat	1	D1	18.04.2009	max. 425	2,4		4300	14,0	3,4	93,6		
		2	D2		max. 425	2,6		3120	20,0	0,4	99,2		
287 ROV	Foggy Corner	1	Niskin	19.04.2009	5 - 8	7,7	264	0,8	54,0	54,4	-0,7		
		2	A1+ZnAc		5 - 8	6,7		26,4	53,0	53,9	0,2		
		3	A2		5 - 8					53,7			
		4	A3		5 - 8	7,2	226	1,8	53,2	54,1	-0,2		
		5	B4		5 - 8	6,9	224	8,3	52,8	53,9	0,3	62	22
	Desperate	6	B5		5 - 8	7,2	215	14,1	53,0	53,7	0,5	41	28
		7	B6		5 - 8	7,2	225	15,2	52,0	53,6	0,8		
		8	C7		5 - 8	7,3	225	0,6	51,7	52,6	2,7		
		9	C8		5 - 8	7,3	227	22,3	53,5	53,3	1,4		
		10	C9		5 - 8	7,4	229	0,6	53,3	53,4	1,1		
297 ROV	Red Lion, Mephisto	2	A1(ZnAc)	21.04.2009	320 - 348	4,6		2654	22,8	23,1	57,3		
		3	A2		348	5,3		1553	36,6	39,3	27,2		
		4	A3		348	4,1		4534	22,3	17,9	66,8		
		5	B4		348	7,3			50,5	50,5	6,5		
		6	B5		348	3,8		4746	11,3	10,7	80,1		
		7	B6		348	5,4		1095	40,4	40,9	24,2		
302 ROV	Sisters Peak	1	D1, Major	22.04.2009		6,7		31	49,5	51,8	4,1		
	Sisters Peak, diffus	5	C8		9.4 - 12.6	6,6			50,7	52,8	2,2		
		6	C7		8 - 12.9	6,7	141	69	49,5	53,0	1,8		
		7	C9		5 - 12	6,7	162	69	50,5	53,1	1,6		
		8	B6		10.5 - 16.2	6,5	122	107	50,5	53,3	1,2	85	20
	Clueless	9	A1		13	6,1		313	50,0	52,2	3,4		
		10	A2		13	6,5			50,0	52,8	2,2		
		11	A3		13	6,6		266	51,0	53,2	1,4	87	13
		12	B4		13	6,5		237	51,5	49,2	8,9		
		13	B5		13	6,5		261	50,0	53,1	1,6	254	27
308 ROV	Sisters Peak	2	A2	23.04.2009	375	3,1			20,8	17,8	66,9		
		3	A1 + ZnAc		375	2,9		6438	17,7	16,7	69,1		
		4	A3		375	2,9		6864	20,1	16,2	70,0		
		5	B4		375	3,8		4009	32,4	18,7	65,3		
		6	B5		375	2,7		4691	18,5	18,5	65,8		
		7	B6		375	2,4		7205	16,0	11,0	79,5		
		8	D2 Major		375	4,2		2753	38,5	36,8	31,8		
314 ROV	Nibelungen Drachenschlund	1	A1+ZnAc	27.04.2009	368 - 370	5,4		477	31,6	29,0	46,3		
		2	A2		369	3,1		1003	7,0	4,6	91,5		
		3	A3		368	2,9		1147	7,0	3,0	94,5		
		4	B4		368	3,2		612	8,9	5,9	89,1		
		5	B5		368	3,1		945	7,2	5,0	90,8		
		6	B6		368	3,3		1106	12,5	5,3	90,1		
		7	C7		90 - 120	5,3	25	7	43,0	45,7	15,4		
		8	C8		90 - 120	5,7		12	45,2	44,9	16,8		
		9	C9		90 - 120	5,8	87	6	44,0	46,0	14,8		
319 ROV	Lilliput main	2	C7	29.04.2009	9.2	6,34		42	53,0	53,4	1,1		
		3	C8		9.2	6,28	90	48	50,8	54,0	0,0	181	33
		4	C9		9.2	6,3	210	42	50,9	53,8	0,4		
		6	A2		9.2	6,37		60	52,5	54,1	-0,3	105	19
		7	A3		9.2	6,33		43	52,8	54,1	-0,1		
		11	B4		9.2	6,35		38	52,8	53,5	0,9		
		12	B5		9.2	6,25	80	50	51,1	53,6	0,7		
		13	B6		9.2	6,35	109	24	52,5	53,9	0,3		
		14	A1+ZnAc		9.2	6,4		58	52,7	53,9	0,2		
324 ROV	Lilliput main	1	A2	30.04.2009	9	6,30		53	52,8	54,1	-0,1		
		2	A3		9	6,34	93	34	52,8	53,5	0,9	91	30
		3	B4		9	6,44	91	35	52,3	53,6	0,8		
		4	B5		9	6,35	84	36	52,0	53,9	0,1	431	39
		5	B6		9	6,32	71	38	52,0	54,0	0,0		
		6	C7		9	6,31		52	51,8	53,7	0,6		
		7	C8		9		69	45	52,5	53,5	0,8		
		8	C9		9	6,30	72	52	51,5	53,8	0,3		
		9	A1+ZnAc		9	6,24		74	50,2	53,1	1,6		
329 ROV	Lilliput main	1	C7	01.05.2009	9	6,48	89	12	52,8	54,3	-0,5		
		2	C8		9	6,58		6	53,4	54,2	-0,3		
		3	C9		9	6,52		25	54,1	53,9	0,1		
335 ROV	Lilliput main	1	A2	02.05.2009	9.8	6,12		29	50,2	48,6	10,1		
		2	A3		9.8	6,13	92	22	50,5	53,5	1,0		
		3	B4		9.8	6,27		20	51,0	53,5	0,8		
		4	A1		9.8	5,99		49	50,2	52,0	3,6		

¤ measured on-shore by ICP-OES at IfG Kiel

2.4.6 Gases in Hydrothermal Fluids and Plumes

(M. Warmuth and S. Herrlich)

2.4.6.1 Introduction

Objective of the work during M78/2 was to characterise hydrothermal fluids and plumes to compare them with data gathered during former MARSUED cruises (M64/1, M68/1 and Atalante leg 2) to monitor the temporal variations within these hydrothermal fields. Subjects of the study were hydrothermal fluids and plumes of three areas along the MAR - Red Lion / Turtle Pits / Wideawake (04°48'S), Nibelungen (8°17´S) and the Liliput hydrothermal field (9°30'S). CH_4, H_2, CO, and CO_2 were measured on board by gas chromatography. Focus was given to hot fluids to obtain information on the sub-surface hydrothermal processes and on diffuse vents emphasizing on the energy and food supply of vent organisms. In addition, the stable carbon and hydrogen isotope ratio of methane from the fluid samples will be measured in the isotope laboratory at the IfBM. The water samples for these analyses were collected from 6 CTD stations and 11 ROV dives. For ROV dives, samples were obtained by three different advices namely the KIPS, titanium in situ gas samplers (MAJORS) and a niskin bottle attached to the front porch of the ROV. To elucidate the transformation of carbon species and reduced gases brought along by hydrothermal fluids, a comprehensive set of samples was secured for on shore analysis of stable isotope contributions (H and C) of fluid components.

In addition, hydrogen was monitored within incubation experiments conducted in cooperation with M. Perner (Biozentrum, Klein Flottbek, Hamburg).

2.4.6.2 Samples and Methodology

For on board measurements of dissolved methane and hydrogen up to 320ml of sample is connected to a high grade vacuum using a technique modified from the method described by Schmitt et al. (1991). Aliquots of the released gas are transferred via a septum from the degassing unit into the analytical system. A gaschromatograph (THERMO TRACE) equipped with a packed stainless steel column (Molecular sieve 5A, carrier gas: He) and a pulse discharge detector (PDD) is used to separate, detect and quantify Hydrogen. Recording and calculation of results is performed using a PC operated integration system (THERMO CHROM CARD A/D). Analytical procedures were calibrated daily with commercial gas standards (LINDE).

CO, CO_2, and CH_4 concentrations of extracted gas were determined using a gas chromatograph (CARLO ERBA, 8000 top). 0.1 to 1 ml of gas was injected on and separated by a 10m long packed column, passed a thermal conductivity detector to a methanizer transforming all oxidized carbon species into CH_4 subsequently quantified by a flame ionization detector. Data are recorded for both detectors by a PC based commercial integration software. Carrier gas was helium, oven temperature was 3 min isotherm 60°C, 40°/min to 120° kept for 10 min.

Samples for the determination of *carbon and hydrogen stable isotope compositions of the dissolved light hydrocarbons* were obtained by degassing the water samples with a vacuum technique (see above). Aliquots of the released gas were transferred by gas tight syringe via a septum from the degassing unit into, gastight glass vials filled with NaCl-saturated water for later on shore analysis by GC-Isotope-Ratio-Mass-Spectrometry. Afterwards the septum is sealed with silicone on the outside.

2.4.6.3 Preliminary Results

The maximum values of hydrogen and methane concentrations measured in a hydrocast (CTD 283) in the plume of the Turtle Pits field were 1278 nM and 51 nM, respectively. That hydrocast must have hit the rising zone of the plume, as the highest values are measured just 50 m above ground in a depth of 2930 m. Concentrations decrease rapidly with decreasing water depth (see fig. 2.4.6..1). Also the H_2/CH_4 ratio in the sample is nearly that of the emanating fluids with 25 in the water sample and 27 in the fluids.

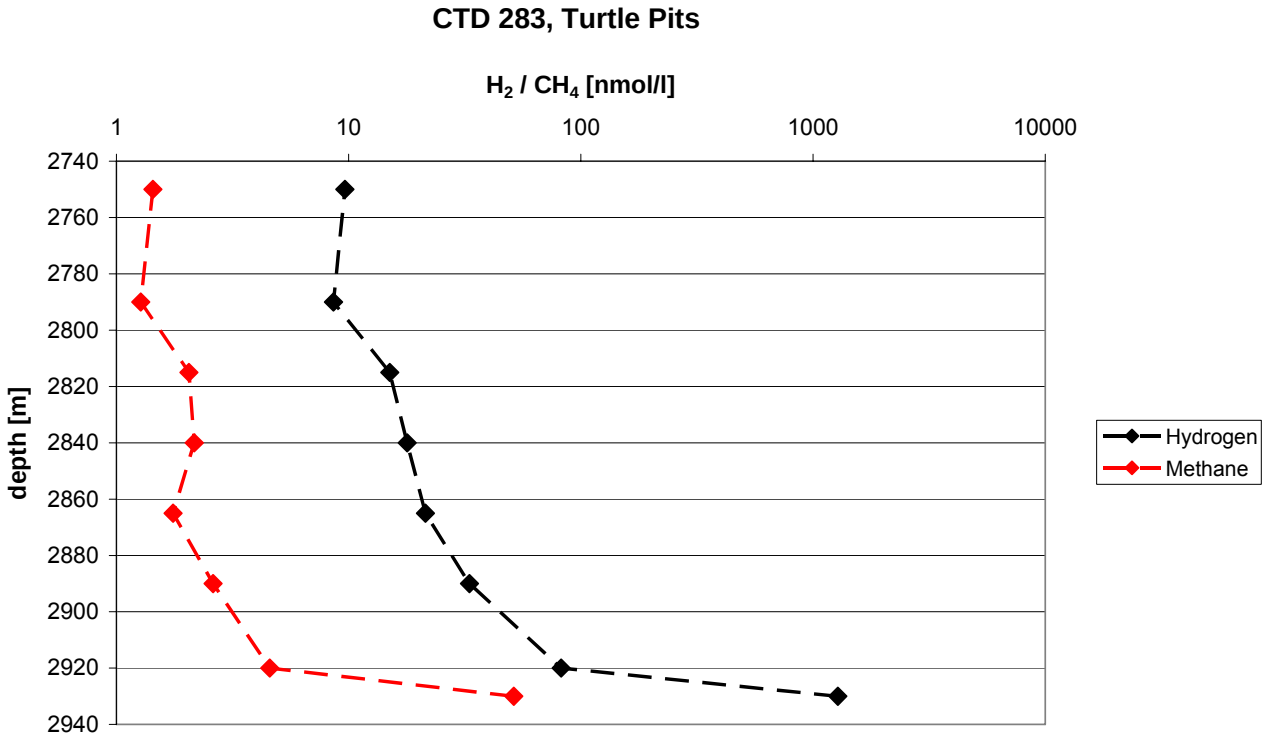


Fig. 2.4.6.1: CH_4 and H_2 concentrations at station 283 CTD

Samples obtained by the ROV directly at the fluid emanations revealed very high concentrations of dissolved hydrogen and Methane. Maximum concentrations found accounted for 0.85 mmol/l and 0.03 mmol/l of hydrogen and methane, respectively. These high values are uncommon for basaltic hosted hydrothermal systems. The resulting H_2/CH_4 ratio of about 27 is still as high as that we measured in 2008 on the "Atalante" cruise (H_2/CH_4 ≈26) and even exceeds those we found for fluids of the Logatchev field (see Table 2.4.6.1).

Tab. 2.4.6.1: **CH_4 and H_2 concentrations found in MOR hydrothermal fluids.**

	H_2 [mmol/l]	CH_4 [mmol/l]	H_2/CH_4 molar ratio	ref.
Atlantic				
Peridotitic host rocks				
Rainbow 36°14'N, MAR	13, 16	2,5	5.2-6.4	1, 2
Logatchev 15°N, MAR	12	2.1	5.7	2, 13
Basaltic host rocks				
Broken Spur 29°N, MAR	0.43 – 1.03	0.07 – 0.13	6.6 – 7.9	3
Menez Gwen 37°17'N, MAR	0.02 – 0.05	1.35 – 2.63	0.01 – 0.02	6
TAG 26°N, MAR	0.15 – 0.37	0.12 – 0.15	1.2 – 2.47	8, 2
MARK 23°N, MAR	0.19 – 0.48	0.02 – 0.06	7.7 – 8.3	10, 11
Lucky Strike 37°17'N, MAR	0.02 – 0.07	0.0 – 0.97	0.03 – 0.07	8
Turtle Pits 04°49'S, MAR	**0.85**	**0.03**	**27.3**	**14**
Red Lion 04°47' S, MAR	**0.4**	**0.06**	**6.4**	**14**
Lilliput 09°33' S, MAR	**0.003**	**0.08**	**0.03**	**14**
Pacific				
Endeavour. JdF, EPR	0.16 – 0.42	1.8 – 3.4	0.1 – 0.12	12
Southern JdF, EPR	0.27 – 0.53	0.08 – 0.12	3.3 – 4.5	9
21°N EPR	0.23 – 1.7	0.06 – 0.09	3.5 – 20	4
Galapagos	0.001 – 0.004	0.1 – 0.4	0.01 – 0.03	5

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

In the Red Lion field the H_2 concentrations (0.41 mmol/l) were stable since our last visit in 2008 (0.43 mmol/l) (see fig. 2.4.6.2). But CH_4 concentrations increased from 0.02 mmol/l in 2008 to 0.06 mmol/l, thus resulting in a lower H_2/CH_4 ratio of 6.4. Since 2006 gas concentrations of both fields increased and at least doubled. Reasons for this change are still unknown but maybe onshore analysis of the stable istotopes of methane will give further indications.

In the diffuse Lilliput field we took samples during high and low tide to determine if there is a tidal influence to the chemistry and biology of the fluids. Therefore we visited and sampled the exact fluid outlet at different times on four following days. During this time period no correlation between tidal intervals and gas concentration could be determined. For further description and other parameters measured during this experiment see section 2.4.7.2

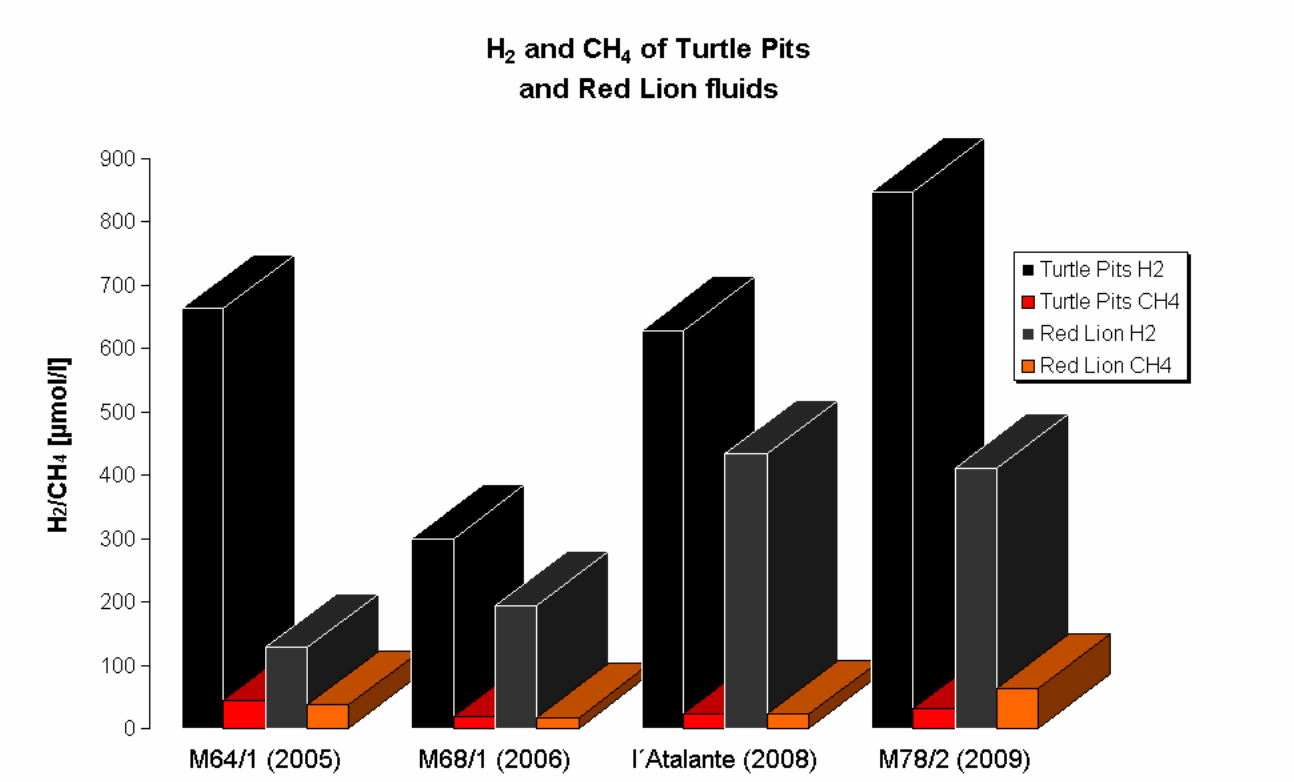


Fig. 2.4.6.2: Methane and hydrogen concentrations of Turtle Pits and Red Lion since 2005.

2.4.7 Microbial Ecology

The main objective of the microbiology group during this cruise was to collect low-temperature, diffuse and hot hydrothermal fluids as well as chimney pieces from the hydrothermal fields located at 5°S, 8°S and 9°S along the Mid-Atlantic-Ridge to investigate:

- *the functioning of the microbial community, specifically focusing on microbial H_2- and H_2S-oxidation coupled to CO_2 fixation*
- *short term temporal variability of microbial community compositions in diffuse fluids*

2.4.7.1 Microbial community composition and its functionality

(Mirjam Perner & Nicolas Rychlik)

We repeated experiments conducted on previous cruises (MSM 06/2, 06/3, 10/3) for investigating the influence of hydrogen and sulfide on microbially mediated autotrophic CO_2 fixation. Here fore, foggy water (Foggy Corner, 5°S, 267 ROV 4), low-temperature, diffuse hydrothermal fluids from the mussel patch from a new site (5°S, 287 ROV 4-7), from Sisters Peak (5°S, 302 ROV 6-8), from Lilliput (9°S, 324 ROV 5-9) and hot fluids from Dragons Throat (8°S, 314 ROV 7-9) were sampled. We supplemented the hydrothermal fluids/plume with either hydrogen (oxic, microaerophilic or anoxic conditions) or sulfide, added the inorganic radioactively labeled carbon, and incubated the liquids for 9-12 hours. Hydrogen uptake (M. Warmuth, University of Hamburg), sulfide concentrations (H. Strauss and C. Breuer, University of Münster), and incorporated amounts of inorganic carbon were determined. Some of this material was collected for microautoradiography and in situ hybridization. Also, parallels were performed for later 16S rRNA community analyses. The highest carbon incorporation rates were mostly determined for the hydrogen supplemented fluids (Fig. 2.4.6.1). However, at the newly discovered site at 5°S (287 ROV 4-7) the substrate consumption and incorporation of CO_2 was the greatest in sulfide amended fluids (Fig. 2.4.7.1). In contrast, at Lilliput hydrogen stimulated CO_2 fixation to the greatest extent and was consumed rapidly. Independent of the inorganic electron donor added to the fluids from Dragon Throat, all incubations with live microbes showed a stimulation of CO_2 fixation, suggesting that the oxidation of a yet unknown energy source, available in the fluids, must be responsible for providing the energy for CO_2 fixation.

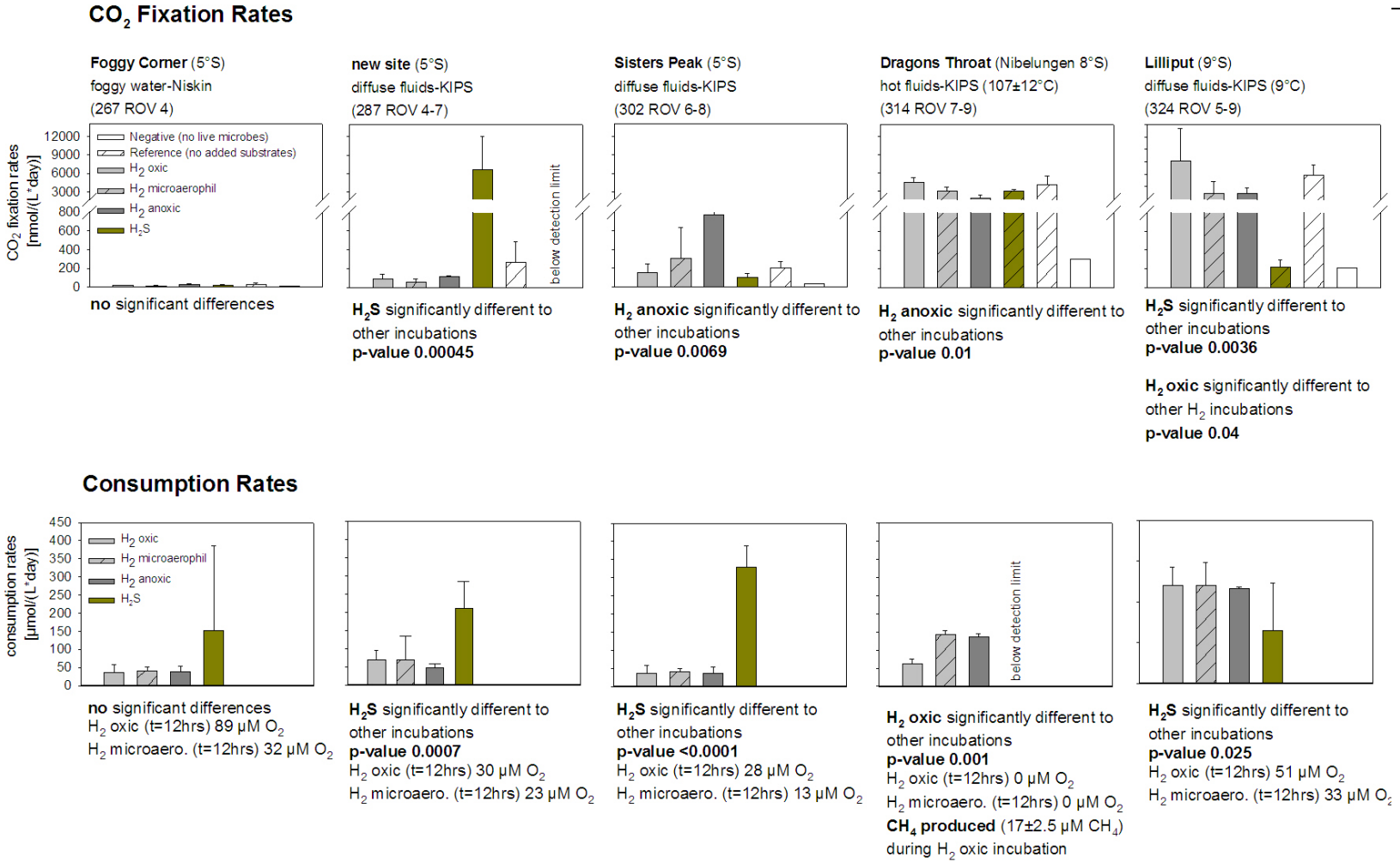


Fig. 2.4.7.1: CO_2 incorporation and consumption rates measured for the fluids without live microbes, with live microbes but without adding substrates and with amending fluids with hydrogen or sulfide. Hydrogen was measured by M. Warmuth (University of Hamburg) and sulfide concentrations were determined by C. Breuer & H. Strauss (University of Münster).

2.4.7.2 Fluid dynamics in chemistry & microbial communities in diffuse fluids

(Mirjam Perner, Dieter Garbe-Schönberg, Harald Strauss, Christian Breuer, Marco Warmuth, Sven Petersen & Christian Mertens)

We collected four diffuse fluid samples from the same spot in the mussel bed at Lilliput (9°S) over different days to investigate the influence of tidal phases on the temperature, chemistry and microbiology. Three KIPS bottles (see also section 1.4.8) were collected from the same site at tidal heights and tidal lows (fig. 2.4.7.2A). Temperature was monitored for this period of time by means of SMoni (Fig. 2.4.7.2B). Hydrogen, methane, sulfide, oxygen and pH were determined on board. Major, trace, and rare earth elements, and microbiology data will be analyzed in the home laboratory.

The temperatures recorded for the diffuse fluids reflect the sea level height (compare Fig. 2.4.7.2A and B) in that during tidal highs temperature decreases. Generally, sulfide and oxygen display the same trend: concentrations are slightly elevated during tidal lows and decreased at tidal highs (Fig. 2.4.7.3A). In contrast, hydrogen and methane concentrations do not correlate with the tidal intervals. In fact, the hydrogen decrease and methane increase (Fig. 2.4.7.3B) could be related to biological processes such as methanogenesis, by which hydrogen and carbon dioxide are microbially used as a substrate with methane as the final product. Methane isotope values determined by R. Seifert and microbiology analyses conducted in the home laboratories will reveal whether this is the case.

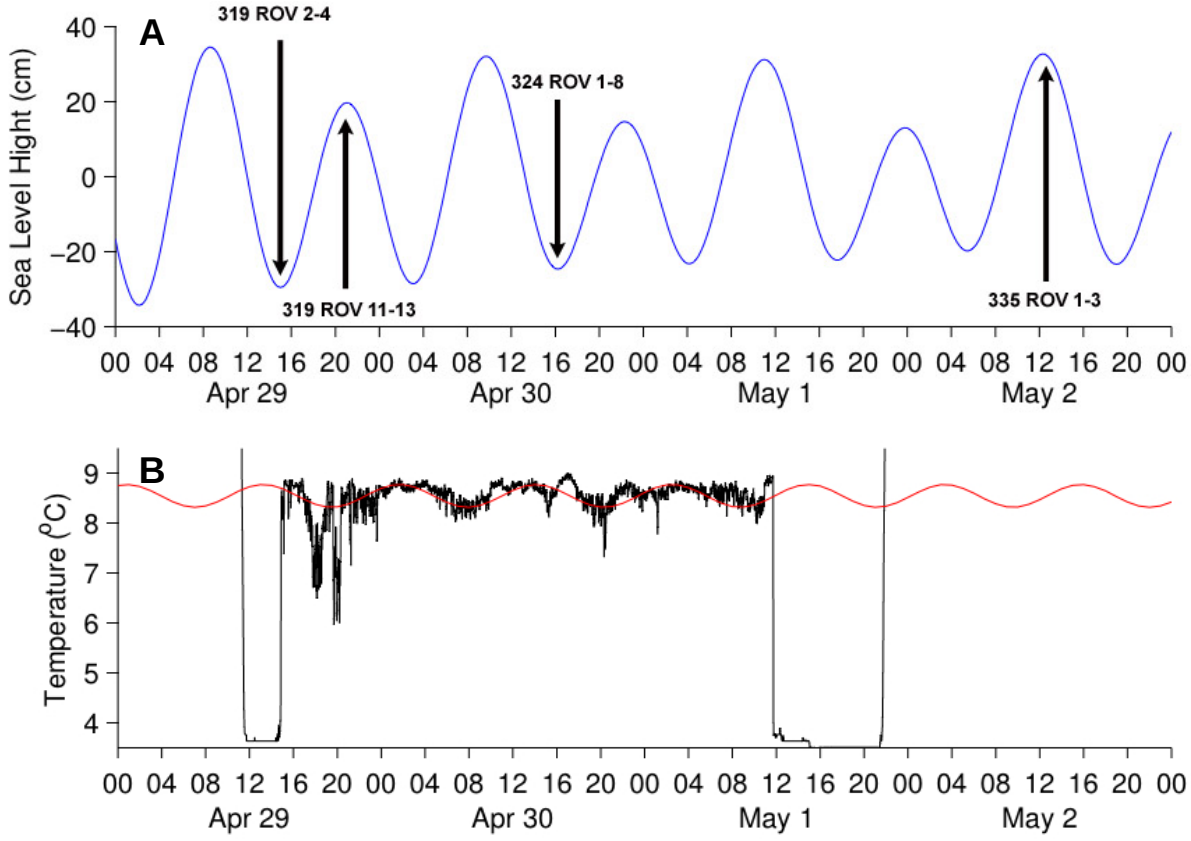


Fig. 2.4.7.2: Sampling of the diffuse fluids during different tidal heights (A) and corresponding temperature of the emanating fluids monitored during this time (B).

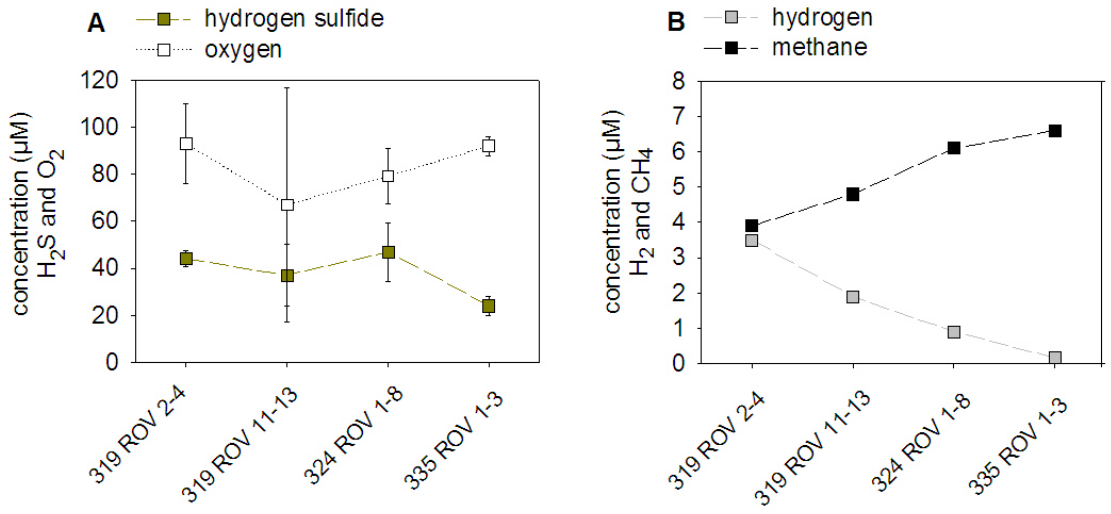


Fig. 2.4.7.3: Sulfide and oxygen (A) and hydrogen and methane (B) concentrations determined for the emanating fluids at Lilliput from the same spot at different tidal intervals.

2.4.7.3 Metal-Complexation Experiments Using Cultures

(Verena Klevenz & Mirjam Perner)

Microbial life at deep-sea hydrothermal vents is exposed to high concentrations of metals present in the venting fluids. Although some of them are biologically essential at low levels, these metals are toxic at high levels. However, toxicity of a metal for the microbes depends on its chemical speciation, as speciation determines the metal's bioavailability.

In order to study the influence of amino acids (AAs) as possible ligands for copper (Cu), with impact on the bioavailability of both (AAs constitute an energy source to microbes) and on the copper's toxicity we have designed a culture experiment: Microbes derived from diffuse fluids of Lilliput (from sample 319 ROV 6-7) were cultured along Cu gradients (from 0 to 10µM) and with three different concentrations of a mixture of 19 proteinogenic AAs (0, 100nM and 1µM).

Shifts in the microbial communities will be monitored, and the concentration of labile Cu, i.e. not complexed by strong organic ligands, of total Cu and of Cu-ligands in the cultures, as well as of the vent sample the microbes are derived of, are measured by voltammetric methods (see section 2.4.5). Furthermore, the AA concentration in the fluid sample will be determined by the use of an HPLC-FD system. The total Cu concentration of the sample was determined after UV-digestion (2h) on board: [Cu] = 19 nM. The rest of the analyses will be carried out in the geochemistry lab at Jacobs University Bremen (voltammetric and HPLC analyses) and in the microbiology lab at University Hamburg (microbial communities).

2.4.8 Hydrothermal Symbioses

(Christian Borowski & Karina van der Heijden)

Metabolic pathways of the symbionts and symbiont activity patterns

One of our main goals within the SPP 1144 is to understand the interactions between hydrothermalism and biology. The vent mussel *Bathymodiolus* sp. harbors two coexisting types of symbionts in its gill tissues: chemolithoautotrophic 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 a carbon source.

In order to study symbiotic activity patterns in relation to the geochemical environment we closely coordinated the collection of symbiotic animals with sampling of diffuse fluids which will be analyzed by the fluid geochemistry groups for dissolved compounds. Mussels were collected in four locations in the 5°S hydrothermal vent area (Foggy Corner, Clueless, Desperate, Golden Valley) and in the Lilliput hydrothermal vent field at 9°S. Animals were dissected as soon as possible upon recovery and symbiont containing tissues were preserved according to the various molecular analyses including DNA and RNA analyses, Fluorescence In Situ Hybridizations (FISH), immunohistochemistry, transmission electron microscopy and analyses for stable isotopes and trace metals.

One of our ongoing projects focuses on the interaction between the composition of dissolved volatiles in the diffuse fluids and the abundances and relative compositions of the symbionts in the host tissues. In previous in situ experiments with *B. puteoserpentis* specimens in the Logatchev Hydrothermal Vent Field (LHF), a shut-off from diffuse fluid flow caused significant decrease of symbiont abundances within only a few days suggesting that abundances and distribution patterns of symbionts directly reflect the availability of reduced compounds in the fluids. With respect to this, we preserved dissected gill tissues throughout the entire gill lengths and separately for inner and outer demibranches for quantitative determinations of symbiotic biovolume and cell numbers. Later 3D FISH based on confocal laser scanning fluorescence microscopy, mRNA FISH and immunohistochemistry will allow to quantify symbionts and to reveal the patterns of their distributions and their specific activities throughout the host body. These data will be compared with quantitative analyses of 16S gene copy numbers using q-PCR and with cell counts using transmission electron microscopy. Correlation with geochemical data of the diffuse fluids at the various collection sites will reveal interaction between fluid composition and symbiotic activity. Further comparisons to similar data obtained from *B. putoserpentis* collected in the ultramaphic-hosted LHF will reveal the influences of different concentrations of sulfide, methane in hydrogen in the contrasting environments.

For analyses of the metabolic pathways of the symbionts, we use FISH methods directly targeting specific functional genes (single gene FISH) or their transcription products (mRNA FISH) and immunohistochemistry methods. A problem for such analyses arises when the animals experience physiological stress due to strong decompression and temperature changes during the ascent of the ROV and long time spans between sampling in the habitat and fixation of the tissues. Changes in the transcription of genes to messenger RNA can occur within minutes, changes in the protein level within hours. We have therefore designed in situ

fixation chambers, called “DieFasts”, for fixing mussels or other biological samples directly on the seafloor within minutes of their collection (Fig. 2.4.8.1). DieFast 1 was already deployed during the MARSUED IV cruise in 2008. The ROV manipulator loads 5-10 mussels in a 3-L fixation chamber and triggers 1 to 3 100-ml syringes that inject concentrated formaldehyde solution into the chamber (end-concentrations in the chamber 1.3, 2.6 or 4%). DieFast 2 uses a saturated salt solution called “RNA Later” instead of formaldehyde and was deployed for the first time in this cruise. RNA Later rapidly penetrates into the cells, inactivates enzymes by denaturation and thereby prevents enzymatic degradation of nucleic acids and proteins

The two DieFasts fit together on the porch of the ROV, and we successfully deployed them simultaneously during dives 302 ROV (Clueless) and 319 ROV (Lilliput). In both locations, we shared out mussels from the same sampling spots to the two DieFasts and an additional batch of mussels that was fixed “conventionally” on board. Animals fixed in formaldehyde solution will later serve for FISH analyses while RNA Later fixations will allow detailed analyses studies of mRNA and enzymes. Comparative analyses of specimens fixed conventionally and in the DieFasts and will reveal the importance of in situ fixation.

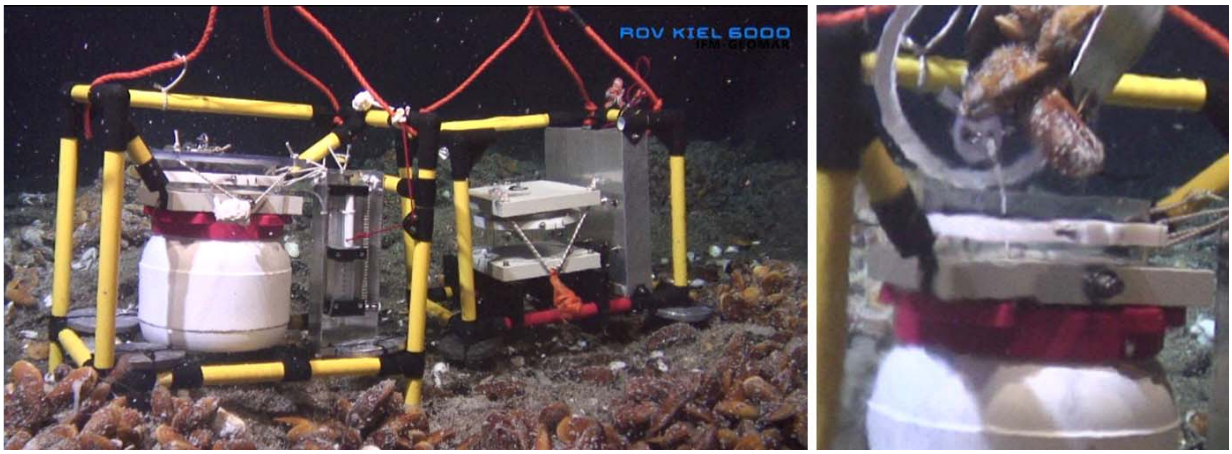


Figure 2.4.8.1: In situ fixation chambers. Left: DieFasts 1 (right) and 2 (left) sitting on the seafloor in “Clueless”. Left: Loading of mussels into a seawater-filled top chamber of DieFast 2. After closing the top lid, a trapdoor opens and the mussels slide down into the RNA Later-filled main chamber (white drum). The two-chamber design was chosen to minimize mixing of the saturated RNA Later solution with seawater during the loading with mussels.

Biogeography and population genetics of hosts and symbionts

The morphology of *Bathymodiolus* sp. specimens collected during previous cruises from the Southern MAR hydrothermal resembled *B. puteoserpentis* from the northern MAR suggesting that they most probably belong to the same species (von Cosel, pers. communication). Our preliminary phylogentic analyses based on the mitochondrial COI and ND4 genes confirmed closest relationship between *Bathymodiolus* specimens from the Wideawake vent field at 4°48° S and *B. puteoserpentis* from the Logatchev Hydrothermal Vent Field at 14°45’ N. Surprisingly, specimens collected in the Lilliput vent field at 9°31’ S clustered with *B. azoricus* from the Rainbow hydrothermal vent field next to the Azores. This throws new light on the possible migration pathways of *Bathymodiolus* along the Mid-

Atlantic Ridge and gives rise to the hypothesis that *Bathymodiolus* possibly colonized the northern MAR at low latitudes and has migrated bidirectional. Our collections from vent sites at 5° S and 9° S contain heterogeneous shell morphologies including specimens that resemble the oval-wedge shaped Logatchev mussels and other elongate ones that appear more similar to *B. azoricus* (not yet analysed in detail). All these findings call for a detailed study of population genetics based on multiple mitochondrial and nuclear gene loci that includes northern and southern MAR populations. This study on host population genetics will be combined with a detailed study of the biogeography of the chemolithoautotrophic and methanotrophic symbionts based on diagnostic microbial genes in order to unravel the biogeography of the *Bathymodiolus* symbiosis on the MAR. For this purpose, we sampled *Bathymodiolus* sp. from all visited diffuse vent sites including Foggy Corner, Clueless, Desperate, Golden Valley and Lilliput. Five to fifteen specimens from each diffuse vent site were dissected as soon as possible upon recovery. Symbiont containing gill tissues will serve for extractions of DNA from the hosts and their symbionts. Additional specimens were entirely frozen.

Growth patterns of Bathymodiolus

When the Lilliput vent field was discovered in April 2005 with Meteor cruise 64/1, recently settled juveniles dominated the mussel populations (Haase et al, 2005), and in 2006, 80% of all individuals were < 10 mm long (Koschinsky et al 2006). In our collections, the size frequency distribution again suggests that 90% of the population is less than one year old and that the supply with settling juveniles was continuous during the recent months (Fig. 2.4.8.2). With respect to the large amount of juveniles in Lilliput in 2005 and 2006, one would have expected to find in 2009 considerable numbers of mid-sized individuals or, in the case of high mortality of the juveniles, large amounts of empty shells. Surprisingly none of this was observed, and the question arises whether Lilliput *Bathymodiolus* grow slower than animals in other populations. We will analyze this with determinations of age and growth patterns on the basis of micro-increment measurements in the shells and compare these with similar data expected from the 5°S sites and from the LHF at 15°N.

Video explorations to the north of Lilliput revealed extended beds of exclusively juvenile mussels covering the pillow lavas, while larger individuals were not observed. This may indicate that the activity of diffuse hydrothermal venting has strongly increased in the entire area since earlier visits by SPP cruises.

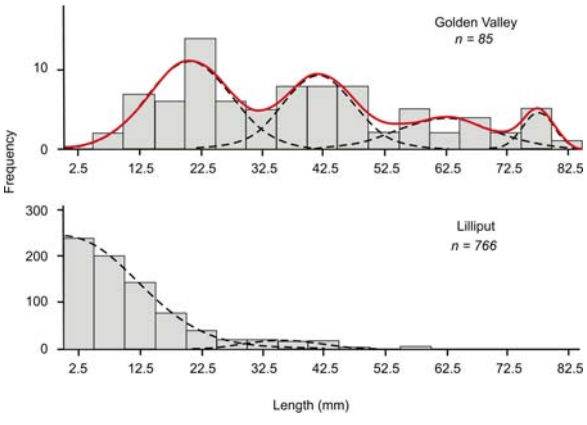


Figure 2.4.8.2: Size frequency distributions of *Bathymodiolus* sp. in Golden Valley (5°S) and Lilliput (9°S). Modal decomposition of the size-frequency data into Gaussian components (calculated with NORMSEP) indicates several groups that have settled during recent rears in Golden Valley, while the majority of Lilliput mussels is < 30 mm long and is therefore suggested to be less than one year old.

2.4.9 Volatile Organohalogens in and Over the Tropical Atlantic Ocean

(F. Laturnus, S. Herrlich, R. Seifert)

2.4.9.1 Introduction

The widespread use of chloro- and chlorofluorohydrocarbons (CFCs) and other volatile organohalogens in our industrialised society cause a large annual release of these compounds into the environment. Besides atmospheric pollution, some of these compounds, for example chloroform, tri- and tetrachloroethene, also constitute a risk for drinking water resources as they can be transported to the groundwater from contaminated field sites or even from atmospheric deposition. These volatile organohalogens have been under scrutiny the recent years as they are a source for halogen radicals involved in various catalytic atmospheric reaction cycles, including the destruction of the stratospheric ozone layers. To avoid a total collapse of the protecting ozone layer against solar ultraviolet radiation, the production and consumption of man-made ozone depleting substances is now controlled by international regulations (e.g. UNEP 1987). Therefore, identification and quantification of sources and sinks are a topic of particular interest. In line with the industrial emissions, also a natural emissions of volatile organohalogen compounds has been identified and several marine and terrestrial sources of volatile organohalogens were discovered (*e.g.* Khalil et al. 1999, Laturnus 2001, Laturnus et al. 2002). Extrapolations of global emissions of volatile organohalogens from natural sources into the atmosphere revealed sources strengths comparable to the industrial input (*e.g.* McCulloch et al. 1999, Keene et al. 1999). For the terrestrial environment several natural sources, such as wetlands, peatlands, salt marshes, rice fields, soil, forests, vulcanos have been found to release mainly chlorinated compounds (*e.g.* Isidorov et al. 1990, Goodwin et al. 1995, Redeker et al. 2000, Yokouchi et al. 2002/2007, Laturnus 2001, Laturnus et al. 2002, Rhew et al. 2002, Scheeren et al. 2003, Manley et al. 2007, Gebhardt et al. 2008). The emission of volatile organobromine and organoiodine compounds from natural terrestrial sources apparently is negligible. Although the terrestrial environment is only 29% of Earth's surface, it is an important major contributor to the occurrence of chloroform and other volatile reactive chlorine-containing compounds in the environment. In the marine environment, the oceans are major sources for volatile organohalogens released into the atmosphere, the origin of these compounds inside the oceans is not yet fully explored. At present, marine macroalgae and microalgae have been identified as a producer of volatile organohalogens. However, they are responsible for only 0.7 to 16% of the annually total released amounts of volatile organohalogens emitted from the oceans. Thus, other so far unknown sources must still exist to balance the global halogen budget.

The aim of this study was to measure the concentrations of volatile organohalogens in air and surface water along a transect from the coast of Guyanna to the Middle Atlantic Ridge to the coast of Brazil. Therefore, possible coastal impacts on volatile organohalogen concentrations may be determined. In a second part of the study, hydrothermal vents in the Middle Atlantic Ridge have been investigated as a possible source for volatile organohalogens.

2.4.9.2 Volatile Organohalogens in air and surface water of the Middle Atlantic

The sampling along the transect started after leaving the exclusive economic zone (EEZ) of Guyanna at 10° 13.07´ N, 56° 38.16´ W. The transect ended with entering the EEZ of Brazil at 17° 11.81´ S, 27° 48.14´ W. Figure x1 shows the sampled transect, which consisted of a total of 56 sampling points. The first part of the transect until 2° 16.98´ N, 35° 42.32´ W went parallel to the coast of Northern Brazil to investigate possible influence of the terrestrial environment on the concentration of volatile halocarbon in air and surface water.

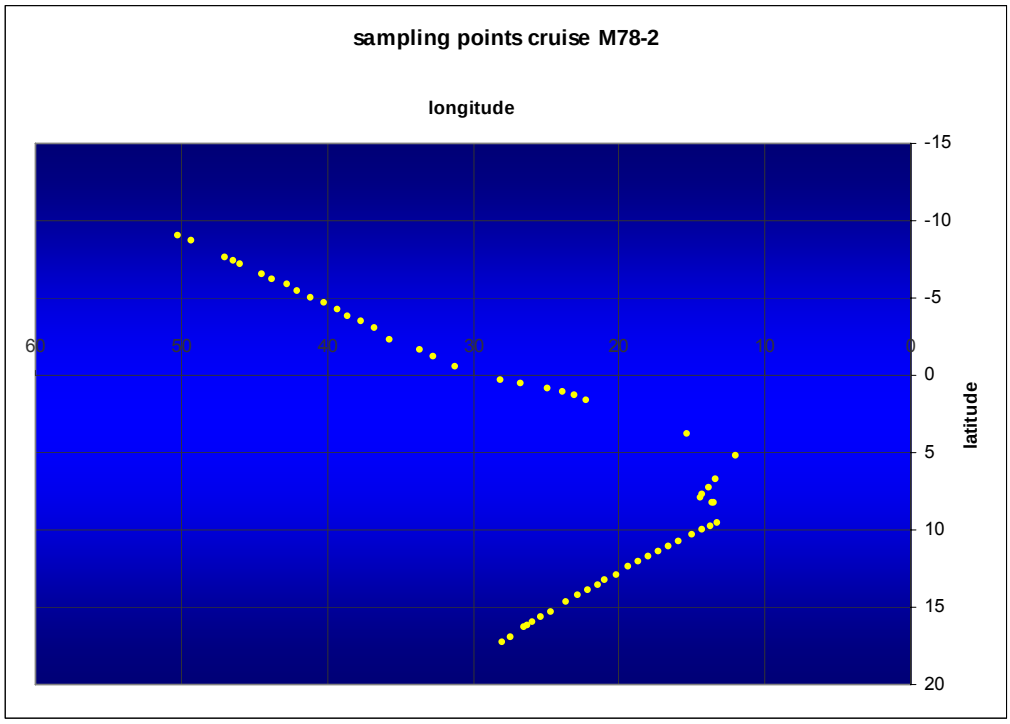


Fig. 2.4.9.1: Sampling points on cruise M78-2 for the determination of volatile organohalogens in air and surface water of the equatorial atlantic ocean.

At every sampling point of the transect an air sample, a surface water sample and a sample for chlorofyll a was taken. Air and water samples have been analyzed directly after sampling by purge-and-trap gas chromatographie with dry electrolytic conductivity detection (p&t-GC-DELCD). The volatile organohalogens identified were methyl chloride (CH_3Cl), methyl bromide (CH_3Br), dichloromethane (CH_2Cl_2), tetrachloromethane (CCl_4), trichoromethane (C_2HCl_3), bromodichloromethane ($CHBrCl_2$), tetrachloroethene (C_2Cl_4), bromoform ($CHBr_3$), and 1,2-dibromoethane (1,2-$EtBr_2$). Chlorophyll concentrations will be determined in the home laboratory first. The averange concentrations in air determined for CH_3Cl, CH_3Br and CH_2Cl_2 were 37.3 pmol L^{-1}, 7.29 pmol L^{-1}, 0,37 pmol L^{-1}, respectively. Comparison of the average air concentration between the sampling transect close to the coast and the sampling transect in the Middle of the Atlantic Ocean revealed slightly higher average concentrations for the area with coastal influence (Table 2.4.9.1). Especially for CH_2Cl_2 a coastal influence on air concentration is visible.

Table 2.4.9.1: Mean concentrations of selected volatile organohalogens in the sampling area closed to the Northern Brazilian coast and the open Atlantic Ocean. The open ocean was defined starting from 2 ° 6.99´N, 35° 42.32´W.

	CH_3Cl	CH_3Br	CH_2Cl_2
	[pmol L^{-1}]		
mean concentration air			
- coastal influence	37.8	7.81	0.70
- open ocean	36.5	7.05	0.25
mean concentration surface water			
- coastal influence	126.1	2.88	43.2
- open ocean	136.1	2.30	25.3

In surface water, the average concentration of the three volatile organohalogens were 136.6 pmol L^{-1}, 2.47 pmol L^{-1}, 30.6 pmol L^{-1}, respectively. The detected concentrations were well in the same range than previous measured concentrations in the marine environment (see Koppmann et al. 1993, Khalil et al. 1999). Compared to their occurrence in ambient air, the concentrations of CH_3Cl and CH_2Cl_2, respectively, in surface water showed around 4 and 82 times, respectively, higher concentrations while CH_3Br revealed an almost three times lower occurrence in the surface water. Furthermore, the concentrations of CH_3Cl and CH_3Br were higher in the coastal influenced air mass of the sampling transect (Table 2.4.9.1). Similar results have been found for surface water except for CH_3Cl, which showed higher concentration in the open ocean area (Table 2.4.9.1).

Table 2.4.9.2: Correlation between the concentrations of chloromethane, bromomethane and dichloromethane in air and surface seawater.

	CH_3Cl		CH_3Br		CH_2Cl_2	
	air	sea	air	sea	air	sea
CH_3Cl						
air		0.158	0.558		0.197	
sea				0.510		0.112
CH_3Br						
air				0.213	0.590	
sea						0.506
CH_2Cl_2						
air						0.344
sea						

Correlation of the concentration of CH_3Cl, CH_3Br and CH_2Cl_2 are given in Table 2.4.9.2. A high correlation coefficient r for a pair of compounds is a first indication for possible similar sources. The first interesting results was an obviously non-correlation between the surface water and air concentrations of all three compounds evaluated. Apparently, the concentrations in air and surface water are not directly related to eachother through simple exchange processes. On the other side, the concentrations of CH_3Cl and CH_3Br in air and surface water, respectively, showed a slight correlation indicating that either their sources or their formation/degradation are related to eachother. In literature, for example a similar formation pathway for CH_3Cl and CH_3Br through a methyl transferase is discussed (*e.g.* Wousmaa and Hager 1990) suggesting similar natural sources for both compounds. Whether or not the origin of both compounds is natural or anthropogenic can not be answered at present. To answer this question, we took samples to investigate the carbon isotope composition of the

volatile organohalogens. However, the results are not yet available. Interesting is that between the concentrations of CH_3Br and CH_2Cl_2 in air and surface water a slight correlation have been found too, while a correlation is missing between the concentrations of CH_3Cl and CH_2Cl_2. This is surprising as so far no similar formation mechanisms have been reported for CH_3Br and CH_2Cl_2. At present, an answer for these findings can not be given.

Other volatile organohalogens, such as CCl_4, C_2HCl_3, $CHBrCl_2$, $CHBr_3$ and 1,2-$EtBr_2$, determined during this study have not yet been evaluated.

2.4.9.3 Release of volatile organohaolgens by hydrothermal vents of the Middle Atlantic Ridge

Investigation of fluid samples directly sampled by an a pumped flow-through system (Kiel Pumping System "KIPS", for details refer to Garbe-Schönberg et al 2006) mounted on a remote operating vehicle (ROV Kiel6000, IfM-GEOMAR). The samples were collected from the KIPS directly after the ROV has emerged from the sea and was fixed on the deck of the research vessel. The samples were filled without headspace in 120mL glass bottles closed with aluminium locks with PTFE covered rubber septum. The samples were stored in a refridgirator until analysis. Determination of volatile organohalogens was achieved within 4 hours after sampling by p&t-GC-DELCD. The volatile organohalogens identified were CH_3Cl, CH_3Br, CH_2Cl_2, CCl_4, C_2HCl_3, $CHBrCl_2$, C_2Cl_4, $CHBr_3$ and 1,2-$EtBr_2$. The concentrations of CH_3Cl, CH_3Br, CH_2Cl_2 determined in the fluids are given in Table 2.4.9.3. CCl_4, C_2HCl_3, $CHBrCl_2$, $CHBr_3$ and 1,2-$EtBr_2$ have not yet been evaluated.

Table 2.4.9.3: Release of selected volatile organohalogens by hydrothermal vents of the Middle Atlantic ridge. The results are corrected to 100% fluid.

vent field	type	percentage fluid in sample	sample name	concentration		
				CH_3Cl	CH_3Br	CH_2Cl_2
		[%]		[nmol L^{-1}]		
Red Lion						
- Mephisto	hot	79.1	297 ROV	2.06	54.4	0.209
Comfortless Cove						
- Sisters Peak	hot	8.33	302 ROV major	21.7	5.46	54.1
- Sisters Peak	hot	62.8	308 ROV 4	5.07	32.8	0.317
- Sisters Peak	diffuse	6.11	302 ROV 2	0.90	1.62	0.245
- Golden Valley	diffuse	0	287 ROV 1	-	-	-
-unknown	diffuse	0.93	287 ROV 9	6.37	42.0	5.16
Turtle Pits						
- One Boat	hot	74.1	281 ROV 1	2.52	0.063	22.1
Nibelungen						
-Drachenschlund	hot	87.0	314 ROV 2/5	3.87/3.28	0.30/0.177	0.60/0.351
Lilliput	diffuse	51.6	319 ROV 6	1.73	0	0.016

The results showed a high input of volatile organohalogens from fluid released from hydrothermal vents into seawater. The concentration for CH_3Cl, CH_3Br and CH_2Cl_2 found in the fluid were between 0.117 and 54.4 nmol L^{-1}, and well above the concentration of the surrounding seawater (0.02 pmol L^{-1} for CH_3Cl, 0 pmol L^{-1} for CH_3Br, 0.003 pmol L^{-1} for CH_2Cl_2). The impact of hydrothermal vents on the concentration of volatile organohalogens were visible through the depths profiles taken above different hydrothermal vents (Figure x2). At the example of CH_3Cl a decrease in the seawater concentration has been found from the surface water down to deep seawater. Close to the hydrothermal vents the CH_3Cl concentrations increased again. The other compounds investigated showed similar distribution.

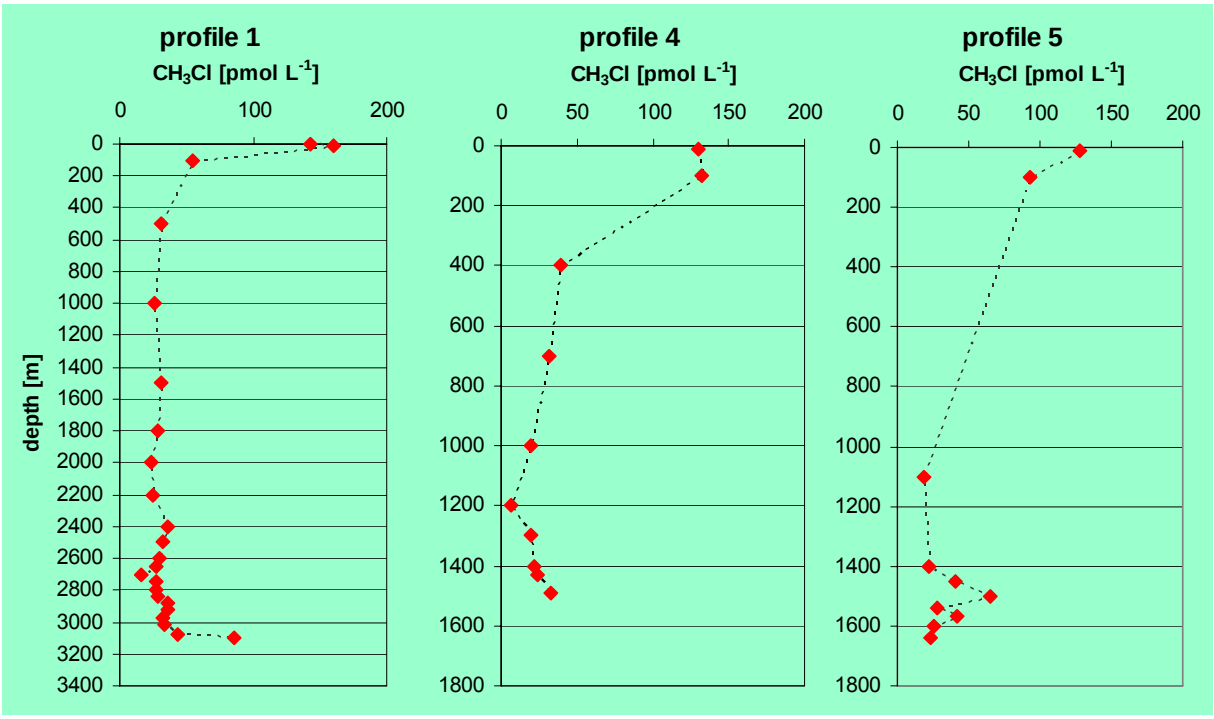


Fig. 2.4.9.2: Depth profiles of CH_3Cl concentrations in the water column at Sisters peak (profile 1, n=23), Nibelungen (profile 4, n=10) and Lilliput (profile 5, n=10).

The sources strength of hydrothermal vents regarding their contribution to the global occurrence of volatile organohalogens still needs to be estimated. However, it is obviously that a novel and important sources for volatile organohalogens has been found, which may close the gap between the determined concentrations of volatile organohalogens in the marine enviroment and the input by biogenic sources so far identified, such as micro- and macroalgae.

2.4.9.4 Conclusion

Natural sources have been found to be significant contributors to the environmental input of volatile organohalogens. However, compared to industrial sources, natural sources can hardly be controlled. Thus, it is important to complete the picture of natural sources contributing to the environmental input of volatile organohalogens. It has been shown that changes of abiotic factors, such as nutrient concentration, temperature, salinity, ultraviolett radiation, can alter the release of volatile organohalogens by natural sources. Therefore, human influences on the environment resulting in uncontrolled eutrophication or further global warming can change the emission of volatile organohalogens by natural sources. For example, the investigations of marine macroalgae showed evidence for a significant increase in the release of these substances when the macroalgae are exposed to elevated levels of ultraviolet radiation. Therefore, increasing emission of volatile organohalogens may be expected in future from natural marine and terrestrial sources, when ultraviolet radiation levels reaching the Earth´s surface still elevates due to a weakening stratospheric ozone layer. This would alter the global atmospheric input and in turn the stratospheric ozone chemistry, and has to be considered when predicting future scenarios in global climate changes.

2.4.10 Temperature Measurements of Hydrothermal Fluids

(D. Garbe-Schönberg)

The mafic-hosted hydrothermal system at 5° S MAR hosts, at present, black smokers venting the hottest fluids ever recorded on the seafloor (Koschinsky et al., 2008). In the southern part of the system at Turtle Pits and Comfortless Cove hydrothermal fluids with lower salinity than seawater originate from a vapor phase after "supercritical" brine condensation and phase-separation. Since discovery of the system in 2005 a constant fluid temperature of ~407 °C has been recorded during the previous cruises. This temperature corresponds to a water depth of 3000m and marks the critical point terminating the boiling curve of seawater. Consequently, all reactions in the sub-seafloor hydrothermal system occur entirely at p,T conditions above the critical curve of seawater. Moreover, short high-temperature pulses >425 °C and a highly variable chemical fluid composition have been identified at these vents. On the other hand, lower temperatures of ~360 °C being too low for phase separation processes characterize the northern part of the hydrothermal system at Red Lion. Main objective for this cruise was the unambiguous reconfirmation of the high temperatures and transient temperature pulses using dedicated sensor and data transfer technology (see Methods in the Appendix). This data will provide the basis for estimates of heat flow of the entire system and a new understanding of the evolution of high-pressure hydrothermal systems in slow-spreading crust. At Nibelungen/ Drachenschlund near 8°55 S a new type of hydrothermal activity in an off-axis position had been discovered but could not be sampled (Melchert et al., 2008). Objective for this cruise was the first sampling and in-situ temperature measurement of the hot fluids from ultramafic host rocks. Besides this, temperature being one parameter for the characterisation of the habitat of biological communities in musselfields was to be measured in diffuse fluids.

2.4.10.1 Hot Fluids from Black Smokers

Turtle Pits – One Boat. During station 281 ROV at the Turtle Pits hydrothermal field all black smoker chimneys - Two Boats, Southern Tower, and One Boat - were surveyed for changes in appearance and activity since our last visits, and for accessibility of orifices. All chimneys were found to be as highly active as in the previous years, venting fluids and black smoke vigorously, but from few small outlets only. Black smoke distributed by bottom currents and accessibility of orifices for the ROV, however, limited sampling to the One Boat chimney. A small orifice in the top region of the ~7m tall chimney was measured and sampled with 2 Major's samplers. The temperature-versus-time plot over seven minutes (Fig. 2, Appendix 2.8) illustrates the challenge to keep the temperature sensor within the fluid. Temperatures change very rapidly during different trials with the ROV'S manipulator to bring the T-probe into the cm-sized fluid outlet with maximum temperature. The maximum temperature recorded was 426 °C, the average temperature was 407 ± 2 °C over a time interval of two minutes (Table 2.4.10.1). These temperatures compare well to temperatures recorded in 2008 and 2006 (Koschinsky et al., 2008).

There is a remarkable difference in the temperature readings from the two sensor types built into the T-probe that has only been observed at the high-temperature vents of Turtle Pits and Comfortless Cove: When the T-probe's temperature rises very rapidly from low to high

temperature, and vice versa, the NTC sensor rises to higher and lower temperatures, respectively, than the simultaneously measuring Pt-1000 sensor. Moreover, the temperature readings from the NTC sensor appear to be more "fine-structured" than readings from the Pt-1000 sensor, with the latter having the appearance of an averaged, smoothed data record.

Table 2.4.10.1: Measured temperatures of hot hydrothermal fluids venting from black smokers

Area	*Site*	*2008* T_{max} *(°C)*	*2009* T_{max} *(°C)*	*2009* T_{avg} *(°C)*	*Fluid sample No.*
Turtle Pits	One Boat	451[1]	426	407 ± 2	281 ROV-1/-2
Comfortless Cove	Sisters Peak	(379)	(375)[2]		308 ROV-2/-8
Red Lion	Mephisto	364	358	353 ± 2	297 ROV-2/-7
Nibelungen	Drachenschlund	(192)[3]	372	371.6 ± 0.1	314 ROV-1/-9

[1] Two Boats was sampled in 2008; [2] No temperature logging for this site, NTC on-line data only. [3] Sampled in 2006, in mixing zone. – Note: Numbers in brackets certainly do not reflect maximum temperatures of undiluted hydrothermal fluid

It is hypothesized that the NTC sensor has a faster response (i.e., reaction time after a temperature change) than the Pt-1000 sensor and, hence, is able to record also very short, transient high-temperature pulses that cannot be "seen" by the Pt-1000 sensor. These pulses probably originate from immiscible ultra-hot fluids (superheated fluid?) ascending with the "normal" 407 °C fluid. This compares to our observation that fluids with different chemical composition vent from the same chimney within short time intervals (Schmidt et al., subm.).

Red Lion – Mephisto. With station 297 ROV all four chimneys at the Red Lion site - Tannenbaum, Shrimp Farm, Sugarhead, Mephisto – were surveyed in the same way as described above before sampling started in the top region of the Mephisto black smoker. Our sampling point was almost the same as in 2008. The maximum temperature measured was 358 °C comparing to 364 °C recorded in 2008 (Tab. 2.4.10.1). The temperature plot (Fig. 2, Appendix 2.8) shows highly variable and unstable temperatures. This indicates that nozzle and temperature probe were not perfectly located within hot venting fluid and, probably, the true maximum temperature of the fluid has been missed.

Comfortless Cove – Sisters Peak. Fluid outlets in the top region of the Sisters Peak chimney appeared to be extremely difficult to reach with the ROV'S manipulator during station 308 ROV. Finally, a small orifice could be sampled and measured. The fact that no clear hydrothermal fluid but only black smoke could be observed at this outlet is also reflected in relatively low maximum fluid temperatures of 375°C. It can be assumed that maximum temperatures of clear undiluted hydrothermal fluid from this chimney would be significantly higher, comparable to the 407 °C as measured at Turtle Pits. Unfortunately, measured temperatures during the dive have been noticed in the protocol as on-line readings only but have mistakenly not been logged.

Nibelungen – Drachenschlund. For the first time, undiluted hydrothermal fluid from the vent Drachenschlund at 8°55 S could be sampled and measured in-situ. Details of the special technical set-up for KIPS and ROV operation at this station 314 ROV are given in the methods section in the Appendix. At Drachenschlund hydrothermal fluids are venting directly from the seafloor without building chimney structures from precipitating sulfides. Scanning the T-probe across the orifice revealed extremely homogenous fluid temperatures indicating

that fluids must leave the orifice with a very high flow rate across a diameter of approx 30 cm. During KIPS fluid sampling the in-situ fluid temperature was measured to 371.6 ± 0.1 °C over a time interval of 20 minutes. Later, samples were taken for microbial diversity studies in a mixing zone between fluid and seawater at 107 ± 12 °C (Fig. 2, Appendix 2.8)

2.4.10.2 Diffuse Fluids in Mussel Fields

Comfortless Cove – Foggy Corner. During stations 267 ROV and 287 ROV diffuse fluids were sampled at Foggy Corner for microbial gene expression studies. Warm "shimmering" water with high turbidity and bacterial flocks was venting from cracks between pillow lava at this site. The nozzle and T-probe were held too high above the fluid outlet, thus yielding temperatures of only 3-3.5 °C during station 267 ROV (Fig. 3, Appendix 2.8), but re-sampling during station 287 ROV was at 7-8 °C (Table 2.4.10.2).

Table 2.4.10.2: Measured temperatures of diffuse hydrothermal fluids in mussel fields

Area	*Site*	*2008* T_{max} *(°C)*	*2009* T_{max} *(°C)*	*Fluid sample No.*
Comfortless Cove	Foggy Corner	9	8.2	267 ROV-2/-4 287 ROV-1/-10
	Clueless, Desperate	10.0[1]	13.6	302 ROV-5/-8
	Sisters Peak	-	16.2	302 ROV-9/-13
Liliput	Liliput Main	6.5	10.6	319 ROV-2/-14 324 ROV-1/-9 329 ROV-1/-3 335 ROV-1/-4

[1] Clueless sampled in 2008 (cruise ATA-2)

Comfortless Cove – Clueless/Desperate. The Clueless mussel fields were investigated during dive 302 ROV. A small pond with a distinct active flow of warm hydrothermal fluids was sampled at a very constant temperature of 12.9 ± 0.2 °C.

Comfortless Cove – Sisters Peak. A small mussel patch within a few meters distance from the Sisters peak black smoker chimney was sampled for the first time, the logged fluid temperature varied between 10 and 16 °C (station 302 ROV).

Liliput – Main site. At the Liliput Main musselfields a dedicated experiment was performed by re-sampling diffuse fluids during both high tide and low tide with stations 319 ROV (low and high tide 1), 324 ROV (low tide 2, no temperature logging), and 335 ROV (high tide 2). A significant correlation of fluid temperature with the tide cycle has been recorded by means of the SMoni autonomous temperature logger (for details see section 2.4.7.2). Sampling temperatures during the four stations were 9.74 ± 0.03 °C (Low Tide 1), 8.3 ± 1.6 °C (High Tide 1), 9.7 °C (Low Tide 2, no logging), and 9.75 ± 0.05 °C (High Tide 2) (Fig. 4, Appendix 2.8).

2.5 Journey Course and Weather

(Harald Rentsch)

The RV "Meteor" left the harbor of Port of Spain one day delayed, in the 4/2/2009 at 13 o'clock local time. At this time a high with 1022 hPa lay with 28N 50 W, his wedge still reached up to the southern Antilles. It was cloudy, nearly 30° Celsius hotly, in the harbor we had wind from 10 to 15 knots, however, it was very quietly and the continual north-east trade wind blew us around the nose. The ship went to the north of Trinidad by a strait in the Atlantic by which nozzle effects generated gusts to 25 knots and a swell of 1.5 m appeared. Our first destination was the area of operation with 4°48' S („Turtle Pits"), which should be reached with an average of 10 knots in 4/15/2009. On the next day a low-pressure area with 1014 hPa shifted with 32N 42W eastward and weakened a little. A matching cold front turned eastward and reached the middle Antilles in weakened form. The journey area itself lay in the area of the north-east trade wind under trouble-free weather. Also during the following two days we remained on the edge of deep atmospheric pressure and a upper-level trough in the zone of the steady north-east trade wind which blew with wind force 4 to 5. The swell running out from north-east reached 2.5 to 3 meters and 1.5 meters of wind sea. The equatorial current (330 degrees, one knot) stood directly opposite the way of the ship. On 4/5/2009 a wedge of subtropical high (1025 hPa, N37 W19) turned away from the day course of the ship "Meteor". With the further approach to the ITCZ cloudiness and shower probability increased. So, in the afternoon, the first shower cells reached us, initiated by conventional processes of the ITCZ. With gusts up to 28 knots, the temperature degreased about 3° within 5 minutes and the visibility decline to 3 km, the compact shower cloudiness moved later from south to the north across the ship's way. The caps of the Cb-cloudiness were measured with 14 km from an infrared satellite image.

A wedge of this subtopic high with approx. N40 W35 with central pressure about 1030 hPa also determined on the subsequent days the weather for the "Meteor". At the same time the period of the shower and thunderstorm probability raised within the ITCZ and moved to the afternoon and evening hours. Therefore it was often sunny dry below a dropping trade wind inversion in the mornings, up to 5 Beaufort and 2.5 m of sea height included.

4/11/2009 ("Equator – Christening"): Meteor had reached the ITCZ, that is why the instability of the atmosphere increased during the day steadily, however, "Meteor" remained still spared from tropical thunderstorms which stroked only in a wide distance of the ship. Near by the equator only low pressure differences existed, so that bringing weak winds from northern directions. The sea remained quiet, swell from 1.5 to 2 m, also still dry, tropical-hot and marvelous weather and a lot of sun during our "Equator – Christening". Within the ITCZ the labiality totally increased in all layers of the atmosphere and thunder clouds could study on the 12.4 in the evening.

On the 11.4, "Meteor" had crossed the equator and moved slowly into the area of the southeast trade winds. With it a stable southeaster direction was based hesitantly. At the same time the high labiality in the atmosphere continued. However, "Meteor" was spared by showers furthermore, in addition the sea remained relatively quiet, and with nearly 28°C maximum temperature, a cloudy sky on Easter day. From here "Meteor" went in the zone of equatorial low-pressure that means with weak winds. Before the southeast trade wind properly

formed up, and also the swell became stronger, sunny-hot and dry weather continued with an easily moved sea. The day maximum of air temperature and water temperature further lay within 28°C. On 4/15/2009 we reached our first area of operation (4° 48‘S, 12° 22‘W) in the trade wind zone. Up to 19.4 by the high water temperature released thermally caused zones of labiality and an ITCZ far shifted to the south single showers or thunderstorms occurred mostly during the evening or night hours particularly with light increase of winds. During the morning hours a passing stabilization and dispersal of clouds could often be observed. Culmination of the instable weather character was on Saturday, 19.4., with huge cloud-clusters, which caused long continual rain-showers and a rain sum of 5 to 10 mm per hour. Only in 2nd day half there was the crossing to a friendlier sun-cloud-mix with only isolated showers. Besides, the southeast trade wind remained weak, the sea relatively quietly. After this rainy Sunday (total sum nearly 10 l / m^2 / h) a friendly sun-cloud-mix with 28 to 29 degrees as a maximum temperature once more expected us on Monday. In the area of the southeast trade wind and light increase of atmospheric pressure occurred, at the same time drier and warmer air masses reached us which contributed to a general weather stabilization namely in higher atmosphere layers. From this date (21.4.) there were only weak showers (0.4 mm / h) in the south edge of the ITZC. The wind remained solidly with wind force 4 from southeast, the sea hardly reached 2 m. On our way to „Inside Corner High“we were already so far away from the ITCZ that the stable, dry subtropics weather of the trade winds asserts itself. With it we had a fine barbecue on this Saturday evening. - Ascension Island expected us on Sunday morning, 26.4., at a picture book sunrise, while we took aboard the film team of the ZDF. Up to the achievement of the next area of operation "Nibelungen" (9 S. 13 W) accompanied us southeast wind with 4 to 5 Beaufort and a parallel swell of 2.5 m. Two days later the desired picture book sundown (17:47 board times) at the shot time for the film team was no experience, because every evening arising clouds covered everything. On the last day of the photographs of ROV and AUV by the ZDF-film team the sun was so hot and the UV radiation charge was so high that sunbathe had to be well measured to get not sunburned. Under influence of a ground high wedge of the subtropics high to the south of 35 S we went with full speed to our last area of operation "Lilliput” together with a consistently, slightly moved sea. Last day of April thicker Sc-fields moved on which had formed below the trade wind inversion. An increasing of pressure-gradient and breezing winds with varying directions stood in connection with a low-pressure area with 30S 18 W which moved eastward and brought showers over the ship. Also the May weather began under influence of the southern subtropics high with 50S. 15 E and the trade wind was diverted by the low-pressure area with 25S 15W temporarily to a more eastern component of force 4 and a swell of 2, later to 3 m. During the following days “Meteor” remained in the area of the subtropics high with 1030 hPa on her journey towards Rio. Because some days before low- pressure-developments took place south of 35 S, a steadily rising swell 3.5 to 4 m reached us up to the 4th of May with periods from 12 to 14 seconds, in the beginning from southeast direction, later from 220 degrees. In addition the wind reaches nearly 5 wind forces. This complicated the work aboard and the drive by the rubber dinghy near by position (16° 20'S, 26° 5'W). On the last part of the trip a high-pressure area with 28S 34 W remained for us weather-determining. Inversion cloudiness, a moderately moved sea with a 3.5-m-high swell, 4 to 5 wind forces from north-east and only a day maximum of 27° Celsius accompanied us in the

territorial waters of Brazil. Together with the equatorial current which turned round here in the Brazil-current and a low-pressure area with 29S 37 W led to tail wind for the "Meteor" which strove with steadily sinking swell with on an average 11 knots against Rio. The journey segment M78 / 2 ended in the morning of the 5/11/2009 with the entrance in the harbor of Rio de Janeiro.

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A 2.1

List of Stations M78/2

Station	Date	Time	Lat	Lon	Depth [m]	Gear
ME782/257	12.04.2009	15:34	01° 0,00' S	23° 59,99' W	3129	AUV
ME782/258	12.04.2009	16:36	00° 59,85' S	23° 59,39' W	3126	FLOAT
ME782/259	14.04.2009	01:27	03° 0,00' S	18° 0,05' W	4785	FLOAT
ME782/260	15.04.2009	13:06	04° 48,63' S	12° 22,40' W	2973	ROV
ME782/261	15.04.2009	15:38	04° 49,73' S	12° 20,99' W	2940	AUV-T
ME782/262	15.04.2009	16:11	04° 47,26' S	12° 21,00' W	3135	AUV-T
ME782/263	15.04.2009	16:50	04° 49,73' S	12° 23,59' W	3000	AUV-T
ME782/264	16.04.2009	01:22	04° 47,46' S	12° 22,61' W	3072	CTD/RO
ME782/265	16.04.2009	04:36	04° 48,32' S	12° 22,26' W	2969	VSR
ME782/266	16.04.2009	07:03	04° 49,41' S	12° 23,60' W		AUV
ME782/267	16.04.2009	14:50	04° 48,19' S	12° 22,32' W	2977	ROV
ME782/268	16.04.2009	17:57	04° 48,14' S	12° 22,32' W		AUV
ME782/269	16.04.2009	19:20	04° 48,49' S	12° 22,21' W	2968	VSR
ME782/270	16.04.2009	23:05	04° 47,40' S	12° 22,60' W	3087	CTD/RO
ME782/271	17.04.2009	02:31	04° 45,83' S	12° 24,85' W	2997	CTD/RO
ME782/272	17.04.2009	06:02	04° 48,27' S	12° 20,99' W	2862	VSR
ME782/273	17.04.2009	08:17	04° 48,34' S	12° 20,98' W	2867	MB
ME782/274	17.04.2009	18:08	04° 48,24' S	12° 22,34' W	2980	ROV
ME782/275	18.04.2009	01:22	04° 45,50' S	12° 23,91' W	3185	CTD/RO
ME782/277	18.04.2009	07:17	04° 44,83' S	12° 22,10' W	3230	CTD/RO
ME782/278	18.04.2009	10:06	04° 44,80' S	12° 22,91' W	3106	VSR
ME782/279	18.04.2009	12:12	04° 48,55' S	12° 22,54' W	2981	ROV
ME782/280	18.04.2009	14:51	04° 48,76' S	12° 20,99' W	2931	VSR
ME782/281	18.04.2009	18:00	04° 48,61' S	12° 22,41' W	2973	ROV
ME782/282	19.04.2009	02:37	04° 44,41' S	12° 21,00' W	3241	CTD/RO
ME782/283	19.04.2009	05:29	04° 48,50' S	12° 23,00' W	2983	CTD/RO
ME782/284	19.04.2009	06:55	04° 49,40' S	12° 23,59' W	2995	AUV
ME782/285	19.04.2009	09:52	04° 49,20' S	12° 21,72' W	2890	VSR
ME782/286	19.04.2009	12:02	04° 49,20' S	12° 21,72' W	2906	VSR
ME782/287	19.04.2009	14:46	04° 48,12' S	12° 22,36' W	2979	ROV
ME782/288	20.04.2009	01:25	04° 52,60' S	12° 23,00' W	3038	CTD/RO
ME782/289	20.04.2009	04:09	04° 52,00' S	12° 21,45' W	3162	CTD/RO
ME782/290	20.04.2009	07:03	04° 48,27' S	12° 23,61' W	2982	VSR
ME782/291	20.04.2009	09:00	04° 49,40' S	12° 23,61' W	3000	AUV
ME782/292	20.04.2009	15:04	04° 50,00' S	12° 22,20' W	2996	VSR
ME782/293	20.04.2009	17:21	04° 43,02' S	12° 21,01' W	2874	MB
ME782/294	21.04.2009	01:07	04° 51,39' S	12° 19,70' W	3106	CTD/RO
ME782/295	21.04.2009	03:54	04° 48,20' S	12° 21,80' W	2943	CTD/RO
ME782/296	21.04.2009	07:18	04° 45,60' S	12° 22,50' W	3152	VSR
ME782/297	21.04.2009	11:24	04° 47,86' S	12° 22,58' W	3018	ROV
ME782/298	21.04.2009	22:52	04° 48,67' S	12° 23,71' W	3001	CTD/RO
ME782/299	22.04.2009	01:36	04° 47,90' S	12° 20,70' W	3016	CTD/RO

Station	Date	Time	Lat	Lon	Depth [m]	Gear
ME782/300	22.04.2009	04:35	04° 45,31' S	12° 23,45' W	3155	VSR
ME782/301	22.04.2009	07:06	04° 48,90' S	12° 23,62' W		AUV
ME782/302	22.04.2009	13:20	04° 48,25' S	12° 22,33' W	2995	ROV
ME782/303	23.04.2009	03:04	04° 51,00' S	12° 22,00' W	3098	VSR
ME782/304	23.04.2009	05:43	04° 49,22' S	12° 22,19' W	2965	CTD/RO
ME782/305	23.04.2009	08:46	04° 47,14' S	12° 21,11' W	3108	AUV-T
ME782/306	23.04.2009	10:04	04° 50,06' S	12° 21,20' W	3048	AUV-T
ME782/307	23.04.2009	11:04	04° 49,95' S	12° 23,73' W		AUV-T
ME782/308	23.04.2009	14:29	04° 48,61' S	12° 22,38' W	2969	ROV
ME782/309	24.04.2009	00:04	04° 48,58' S	12° 22,40' W	2969	MB
ME782/310	24.04.2009	13:12	05° 6,09' S	11° 41,08' W	1517	ROV
ME782/311	24.04.2009	23:12	05° 7,59' S	11° 41,50' W	1894	MB
ME782/312	26.04.2009	16:32	08° 17,92' S	13° 30,42' W	2948	ROV
ME782/313	26.04.2009	22:54	08° 20,08' S	13° 35,00' W	2997	MB
ME782/314	27.04.2009	10:01	08° 17,83' S	13° 30,53' W	2886	ROV
ME782/315	27.04.2009	19:37	08° 17,06' S	13° 26,01' W	2947	MB
ME782/316	29.04.2009	05:48	09° 31,67' S	13° 11,91' W	1652	AUV-T
ME782/317	29.04.2009	06:11	09° 33,12' S	13° 11,93' W	1538	AUV-T
ME782/318	29.04.2009	09:05	09° 31,70' S	13° 12,24' W		AUV
ME782/319	29.04.2009	11:11	09° 32,85' S	13° 12,64' W	1489	ROV
ME782/320	29.04.2009	15:10	09° 32,91' S	13° 12,53' W	1489	AUV
ME782/321	29.04.2009	23:45	09° 32,85' S	13° 12,45' W	1487	CTD/RO
ME782/322	30.04.2009	01:41	09° 32,51' S	13° 14,00' W	1642	CTD/RO
ME782/323	30.04.2009	08:53	09° 31,48' S	13° 12,83' W	1522	VSR
ME782/324	30.04.2009	11:50	09° 32,63' S	13° 12,77' W	1519	ROV
ME782/325	30.04.2009	15:17	09° 33,04' S	13° 12,49' W	1510	AUV
ME782/326	30.04.2009	22:56	09° 31,86' S	13° 11,60' W	1666	CTD/RO
ME782/327	01.05.2009	00:28	09° 31,46' S	13° 11,83' W	1638	CTD/RO
ME782/328	01.05.2009	01:32	09° 29,61' S	13° 12,23' W	1724	MB
ME782/329	01.05.2009	09:48	09° 32,50' S	13° 12,57' W	1501	ROV
ME782/330	01.05.2009	11:24	09° 32,85' S	13° 12,52' W		AUV
ME782/331	01.05.2009	23:16	09° 32,30' S	13° 11,29' W	1672	CTD/RO
ME782/332	02.05.2009	03:51	09° 31,81' S	13° 12,31' W	1509	CTD/RO
ME782/333	02.05.2009	06:39	09° 30,03' S	13° 14,47' W	1785	MB
ME782/334	02.05.2009	09:46	09° 33,31' S	13° 11,84' W		AUV-T
ME782/335	02.05.2009	11:52	09° 32,82' S	13° 12,55' W	1491	ROV
ME782/336	02.05.2009	15:58	09° 33,23' S	13° 12,38' W	1465	AUV
ME782/337	03.05.2009	00:38	09° 33,10' S	13° 12,40' W	1490	CTD/RO
ME782/338	03.05.2009	02:07	09° 32,60' S	13° 12,50' W	1507	CTD/RO
ME782/339	03.05.2009	03:45	09° 32,00' S	13° 12,60' W	1533	CTD/RO
ME782/340	03.05.2009	04:50	09° 28,68' S	13° 10,49' W	2017	MB
ME782/341	03.05.2009	10:25	09° 32,99' S	13° 11,88' W	1561	AUV-T
ME782/342	04.05.2009	16:29	11° 59,99' S	18° 30,00' W	4358	FLOAT

Station	Date	Time	Lat	Lon	Depth [m]	Gear
ME782/343	06.05.2009	14:44	16° 9,26' S	26° 18,72' W	6028	ROV
ME782/344	06.05.2009	15:00	16° 9,28' S	26° 18,71' W	6029	AUV
ME782/344	06.05.2009	15:04	16° 9,29' S	26° 18,73' W	6018	AUV

Cruise: MAR SOUTH V
Date: 16.04.2009
Station: M78-2_267ROV
Targets: *Foggy Corner*

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:52:22	-4.80218	-12.37252	938	331	0	-4.8031669	-12.37183	2978	IN THE WATER
14:50:24	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37200	2976	AT THE BOTTOM
14:50:56	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2980	pillow lava, < 50% sediment
14:51:43	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2978	pillows allover
14:51:57	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2978	fish
14:52:22	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2978	eel-like
14:52:47	-4.80592	-12.37577	2973	--	--	-4.803	-12.37183	2974	5.7 above bottom
14:53:40	-4.80592	-12.37577	2973	--	--	-4.803	-12.37183	2978	not very foggy, so, foggy corner not yet reached
14:54:12	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2977	still on same spot of bottom contact
14:54:56	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2974	start moving 18°
14:56:46	-4.80592	-12.37577	2973	--	--	-4.803	-12.37183	2976	anemonies on pillows? camera too far away
14:57:52	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2977	pillow lava, unsedimented
14:58:16	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2975	fish
14:59:04	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2976	fissures in pillow surfaces somteimes with white edges
14:59:30	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2974	fish
14:59:43	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2978	pillow lava, unsedimented
15:00:32	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2977	climbing uphill
15:00:55	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2975	stop moving
15:02:55	-4.80592	-12.37577	2973	--	--	-4.8031669	-12.37183	2977	crabs loosely scattered
15:04:13	-4.80592	-12.37577	2973	--	--	-4.803	-12.37183	2978	looking aroung
15:04:43	-4.80278	-12.37173	2985	148	2.6	-4.803	-12.37183	2976	bacterial mat, patchy
15:04:46	-4.80278	-12.37177	2985	148	2.5	-4.8031669	-12.37183	2976	mussel patch
15:05:44	-4.80273	-12.37178	2983	99	3.9	-4.8031669	-12.37183	2977	first pillows with hydrothemal organisms
15:06:49	-4.80270	-12.37182	2983	20	4.3	-4.8031669	-12.37183	2977	patch less than 2 m wide
15:07:01	-4.80273	-12.37183	2983	324	4.9	-4.8031669	-12.37183	2978	not very foggy
15:07:31	-4.80273	-12.37178	2981	42	6.1	-4.8031669	-12.37183	2978	but right on msapped position
15:07:56	-4.80273	-12.37182	2984	41	3.8	-4.803	-12.37183	2977	diffuse outflow
15:12:07	-4.80277	-12.37175	2986	53	1.4	-4.8031669	-12.37183	2979	we are possibly only 10 m off the target, but not right on it
15:13:15	-4.80283	-12.37182	2986	53	1.4	-4.8031669	-12.37183	2978	with respect to oil leakage, we check here for T-anomalies and chance for sampling
15:13:45	-4.80280	-12.37178	2986	53	1.1	-4.8031669	-12.37183	2977	getting closer to the sptt
15:14:44	-4.80277	-12.37175	2987	71	0.2	-4.8031669	-12.37183	2976	diffise outflow from hole at basis of the pillow
15:14:57	-4.80278	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:15:08	-4.80277	-12.37180	2987	70	0.2	-4.8031669	-12.37183	2977	still image
15:16:26	-4.80277	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2978	still image
15:17:08	-4.80277	-12.37183	2987	71	0.2	-4.8031669	-12.37183	2978	HD ON
15:17:40	-4.80278	-12.37185	2987	71	0.2	-4.8031669	-12.37183	2978	a few particles in the water
15:18:29	-4.80275	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2976	still image
15:19:08	-4.80278	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:19:24	-4.80278	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2975	HD OFF
15:19:35	-4.80278	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2976	still image
15:19:59	-4.80277	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2976	still image
15:20:58	-4.80273	-12.37175	2987	71	0.2	-4.8031669	-12.37183	2976	mussels in various patches many of them on pillow walls
15:22:08	-4.80275	-12.37177	2987	71	0.2	-4.8031669	-12.37183	2978	still image
15:22:27	-4.80275	-12.37177	2987	71	0.2	-4.803	-12.37183	2974	still image
15:22:44	-4.80275	-12.37177	2987	71	0.2	-4.8031669	-12.37183	2975	crab in musselpatch
15:22:59	-4.80273	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2977	start looking for sampling spot
15:25:30	-4.80278	-12.37182	2987	70	0.2	-4.8031669	-12.37183	2975	correction of site characterization: we have already moed to another spot a few meters eastwards
15:26:25	-4.80272	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2977	this site is at least 5 x 5 m, so may be identicle with "foggy corner"
15:26:37	-4.80272	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2978	flush kips
15:27:45	-4.80275	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2977	flushing done, grab kips handle
15:30:05	-4.80275	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2976	compensator status is on 35%, if oil leakage continues like that, we must dive up in 30 min
15:31:04	-4.80270	-12.37177	2987	71	0.2	-4.8031669	-12.37183	2977	kips nozzle next to outflow hole
15:31:38	-4.80275	-12.37180	2987	71	0.2	-4.803	-12.37183	2977	swater very slighty shimmering
15:32:54	-4.80273	-12.37183	2987	71	0.2	-4.803	-12.37183	2976	crabs and a shrimpnext to outflow hole, not Rimicaris
15:34:57	-4.80275	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2976	Kips T- handle broke, therefore kips nozzle cannot be pushed further into hole.
15:35:31	-4.80273	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2976	KIPS ON
15:35:32	-4.80273	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2976	**267ROV_1(KIPS A2)**
15:35:52	-4.80278	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2977	T= 3.5-4.2°C, prepare for sampling with 3 kips bottles
15:35:57	-4.80280	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2977	KIPS ON
15:36:26	-4.80275	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2975	kips A2 on since 15:33
15:37:48	-4.80277	-12.37180	2987	--	--	-4.8031669	-12.37183	2978	white flocks in water column
15:38:25	-4.80283	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2976	pillows covered with white material, looks somewhat similar to flocks
15:39:18	-4.80278	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2978	still image
15:39:30	-4.80278	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2976	still image
15:40:05	-4.80273	-12.37183	2987	--	--	-4.8031669	-12.37183	2977	KIPS OFF
15:40:29	-4.80275	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2977	red shrimp
15:40:44	-4.80272	-12.37180	2987	70	0.2	-4.8031669	-12.37183	2975	still image
15:41:13	-4.80270	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:41:15	-4.80270	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2976	KIPS ON

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
15:41:15	-4.80270	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2976	**267ROV2 (KIPS A3)**
15:41:36	-4.80268	-12.37177	2987	71	0.2	-4.8031669	-12.37183	2976	start pumping kips A3
15:41:38	-4.80270	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2978	still image
15:41:49	-4.80270	-12.37180	2987	71	0.2	-4.803	-12.37183	2978	still image
15:43:54	-4.80278	-12.37182	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:44:27	-4.80277	-12.37178	2987	71	0.2	-4.803	-12.37183	2976	still image
15:44:34	-4.80278	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2979	still image
15:44:51	-4.80275	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:44:51	-4.80275	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:44:52	-4.80275	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:45:26	-4.80272	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2977	still image
15:45:49	-4.80268	-12.37178	2987	71	0.2	-4.803	-12.37183	2980	HD ON
15:47:26	-4.80272	-12.37178	2987	71	0.2	-4.8031669	-12.37183	2978	KIPS OFF
15:47:45	-4.80272	-12.37178	2987	71	0.2	-4.8031669	-12.37200	2977	KIPS ON
15:47:45	-4.80272	-12.37178	2987	71	0.2	-4.8031669	-12.37200	2977	**267ROV3 (KIPS B4)**
15:48:12	-4.80273	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2978	start pumping B4
15:48:55	-4.80270	-12.37180	2987	71	0.2	-4.8031669	-12.37183	2979	HD OFF
15:52:29	-4.80270	-12.37180	2987	71	0.2	-4.8031669	-12.37200	2975	kips t = 3.2°C
15:53:13	-4.80268	-12.37182	2987	71	0.2	-4.8031669	-12.37200	2977	KIPS OFF
15:53:31	-4.80265	-12.37185	2987	71	0.2	-4.8031669	-12.37200	2977	end of sample 3: 15:53
15:54:55	-4.80268	-12.37180	2987	71	0.2	-4.8031669	-12.37200	2980	finished sampling the three fluid bottles and will now collect the mussel sample with net bc 30% compensator content and need to ascend
15:55:58	-4.80270	-12.37182	2987	71	0.2	-4.8031669	-12.37200	2977	**267ROV4**
15:56:14	-4.80273	-12.37178	2987	70	0.2	-4.8031669	-12.37200	2979	filling niskin
15:58:20	-4.80272	-12.37183	2987	71	0.2	-4.8031669	-12.37183	2978	grabbing mussel net
16:01:12	-4.80267	-12.37180	2987	70	0.2	-4.8031669	-12.37200	2976	HD ON
16:03:53	-4.80295	-12.37195	2987	--	--	-4.8031669	-12.37200	2975	scooping mussels
16:04:54	-4.80295	-12.37195	2987	--	--	-4.8031669	-12.37183	2974	cant reach the mssels
16:06:59	-4.80272	-12.37177	2987	77	0.7	-4.803	-12.37183	2976	HD OFF
16:09:02	-4.80268	-12.37172	2987	77	0.7	-4.8031669	-12.37183	2977	**267ROV5**, mussel net
16:11:01	-4.80277	-12.37172	2987	77	0.7	-4.803	-12.37183	2974	putting mussel net into grey box to keep them from being flushed by the ambient seawater during ascent
16:11:57	-4.80270	-12.37173	2987	77	0.7	-4.803	-12.37183	2977	HD ON
16:12:15	-4.80270	-12.37175	2987	77	0.7	-4.803	-12.37183	2976	HD OFF
16:14:07	-4.80263	-12.37175	2987	77	1.1	-4.803	-12.37183	2977	ascending
16:15:28	-4.80268	-12.37182	2957	40	30.7	-4.8031669	-12.37183	2979	OFF THE BOTTOM
17:38:28	-4.80268	-12.37207	4	--	--	-4.8066669	-12.37483	0	ON DECK

Cruise: MAR SOUTH V
Date: 17.04.2009
Station: M78-2_274ROV
Targets: Sisters Peak and Golden Valley

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
16:32:00									IN THE WATER
18:08:30	-4.80322	-12.37190	2984	79	4.9	-4.803833	-12.3723326	2977	AT THE BOTTOM
18:11:17	-4.80322	-12.37188	2984	79	5.0	-4.803833	-12.3723326	2979	pillow lava, unsedimented
18:12:07	-4.80322	-12.37190	2984	79	4.9	-4.803833	-12.3723326	2976	at bottom with nice pillows, probably SW of Foggy Corner
18:14:57	-4.80328	-12.37192	2984	74	4.7	-4.803833	-12.3723326	2977	HD ON
18:15:30	-4.80320	-12.37193	2982	74	5.9	-4.803833	-12.3723326	2976	abundant snow in the water
18:15:44	-4.80322	-12.37190	2979	75	7.3	-4.803833	-12.3723326	2976	heading 070 towards Foggy Corner
18:16:35	-4.80320	-12.37187	2979	78	7.0	-4.803833	-12.3723326	2977	HD OFF
18:18:44	-4.80323	-12.37202	2986	71	7.2	-4.803833	-12.3723326	2977	lobate flow, unsedimented
18:18:49	-4.80325	-12.37202	2987	69	5.1	-4.803833	-12.3723326	2977	fish
18:19:19	-4.80325	-12.37197	2989	71	4.1	-4.803833	-12.3723326	2977	Actinaria
18:21:26	-4.80322	-12.37200	2991	88	2.4	-4.803833	-12.3723326	2978	HD ON
18:21:48	-4.80323	-12.37202	2991	102	2.6	-4.803833	-12.3721666	2978	Crab
18:22:31	-4.80315	-12.37192	2989	82	3.2	-4.8036671	-12.3721666	2980	HD OFF
18:23:00	-4.80320	-12.37185	2989	87	3.3	-4.8036671	-12.3721666	2980	still on the same spot, waiting for the ship to move
18:25:24	-4.80308	-12.37188	2991	153	2.8	-4.8035002	-12.3719997	2977	white bacteria on pillow surfaces
18:25:44	-4.80315	-12.37190	2991	179	2.7	-4.8035002	-12.3719997	2976	pillow lava, unsedimented
18:26:25	-4.80310	-12.37188	2991	206	2.0	-4.8035002	-12.3719997	2979	jumbled lava
18:27:49	-4.80310	-12.37192	2992	247	2.1	-4.8035002	-12.3719997	2977	Crab
18:28:05	-4.80312	-12.37193	2992	247	2.2	-4.8035002	-12.3719997	2976	crab number increasing while approachin white patch
18:28:32	-4.80312	-12.37193	2992	250	2.6	-4.8035002	-12.3719997	2977	sulfide talus
18:29:35	-4.80315	-12.37197	2992	220	2.7	-4.8035002	-12.3719997	2976	at base of sisters peak ?
18:33:10	-4.80313	-12.37197	2993	--	--	-4.8035002	-12.3719997	2976	HD OFF
18:36:58	-4.80317	-12.37192	2993	296	1.9	-4.8035002	-12.3719997	2977	jumbled lava and sulfide talus at the base of Sisters Peak, confirmed by MNarker 5
18:37:00	-4.80317	-12.37192	2993	296	2.2	-4.8035002	-12.3719997	2977	HD ON
18:39:09	-4.80317	-12.37193	2987	267	6.7	-4.8035002	-12.3719997	2977	HD OFF
18:42:02	-4.80318	-12.37198	2975	277	18.9	-4.8035002	-12.3719997	2979	rising along inactive chimney on SE side, followed by movement away of the snoker in order to get out of the smoke
18:42:24	-4.80320	-12.37197	2975	54	19.6	-4.8035002	-12.3719997	2980	in the plume! 20m above bottom
18:43:02	-4.80322	-12.37198	2977	78	17.8	-4.8035002	-12.3719997	2976	HD ON
18:46:24	-4.80318	-12.37200	2989	114	5.5	-4.8035002	-12.3719997	2977	HD OFF
18:48:53	-4.80318	-12.37200	2991	94	4.4	-4.8035002	-12.3719997	2977	at the base again, sulfide talus
18:49:09	-4.80318	-12.37200	2991	94	4.3	-4.8035002	-12.3719997	2976	depth at the base is at least 2991m
18:50:33	-4.80323	-12.37197	2987	71	7.8	-4.8035002	-12.3719997	2979	HD ON
18:51:52	-4.80320	-12.37193	2984	61	9.8	-4.8035002	-12.3719997	2976	HD OFF
18:57:22	-4.80320	-12.37195	2985	22	9.5	-4.8035002	-12.3719997	2978	preparing to take a sulfide/microbiology sample
19:02:34	-4.80320	-12.37195	2980	350	12.3	-4.8035002	-12.3719997	2981	HD ON
19:03:06	-4.80317	-12.37197	2979	16	14.5	-4.8035002	-12.3719997	2976	HD OFF
19:04:59	-4.80323	-12.37192	2980	318	15.0	-4.8035002	-12.3719997	2977	**sample 274ROV-1**
19:04:59	-4.80323	-12.37192	2980	318	15.0	-4.8035002	-12.3719997	2977	sample of large beehive with small black smoker on top
19:26:29	-4.80318	-12.37188	2994	284	0.4	-4.8035002	-12.3719997	2977	sample replaced and secured on the porch, trying to brake small knob for white drum
19:33:31	-4.80320	-12.37188	2972	106	22.1	-4.8035002	-12.3719997	2976	closing sample barrel
19:34:04	-4.80320	-12.37195	2976	38	16.1	-4.8035002	-12.3719997	2978	barrel closed
19:36:25	-4.80307	-12.37192	2991	74	2.4	-4.8035002	-12.3719997	2978	start to move to Golden Valley
19:36:31	-4.80307	-12.37192	2991	74	3.0	-4.8035002	-12.3719997	2983	HD ON
19:37:13	-4.80303	-12.37190	2990	76	3.5	-4.8035002	-12.3719997	2982	pillow lava, unsedimented
19:37:52	-4.80305	-12.37190	2988	57	4.4	-4.8035002	-12.3719997	2978	still fauna
19:38:03	-4.80305	-12.37192	2989	57	2.9	-4.8035002	-12.3719997	2978	HD OFF
19:43:36	-4.80298	-12.37188	2986	60	4.0	-4.8035002	-12.3719997	2977	flying above unsedimented pillows
19:46:37	-4.80287	-12.37168	2985	73	3.5	-4.8033328	-12.3718328	2975	pillow lava, unsedimented
19:47:35	-4.80282	-12.37162	2985	91	3.3	-4.8033328	-12.3716669	2976	HD ON
19:49:00	-4.80278	-12.37155	2982	90	4.0	-4.8033328	-12.3716669	2977	waters becomes more foggy, abundand snow
19:49:23	-4.80272	-12.37155	2982	90	2.9	-4.8033328	-12.3716669	2978	broken pillows
19:50:31	-4.80270	-12.37147	2982	105	3.1	-4.8033328	-12.3716669	2978	HD OFF
19:51:57	-4.80275	-12.37142	2982	115	2.2	-4.8031669	-12.3716669	2982	Crab
19:52:14	-4.80277	-12.37142	2981	114	2.7	-4.8031669	-12.3715	2977	pillow lava, unsedimented
19:53:42	-4.80273	-12.37137	2981	96	3.6	-4.8031669	-12.3715	2977	turning N
19:53:56	-4.80268	-12.37133	2980	71	3.5	-4.8031669	-12.3715	2975	pillow lava, unsedimented
19:54:50	-4.80260	-12.37133	2980	4	3.3	-4.8031669	-12.3715	2976	broken pillows
19:55:05	-4.80258	-12.37137	2980	355	3.2	-4.803	-12.3715	2977	fissure
19:55:08	-4.80258	-12.37137	2980	356	3.0	-4.803	-12.3713331	2976	HD ON
19:56:19	-4.80258	-12.37137	2981	32	3.5	-4.803	-12.3713331	2976	mussel shells, patchy
19:57:40	-4.80255	-12.37138	2984	263	1.6	-4.803	-12.3713331	2978	turning 180
19:57:54	-4.80252	-12.37135	2984	221	1.3	-4.803	-12.3713331	2978	Crab
19:58:34	-4.80253	-12.37140	2984	179	2.0	-4.803	-12.3713331	2980	flying south
19:59:25	-4.80257	-12.37142	2985	170	2.6	-4.803	-12.3713331	2976	pillow lava, unsedimented
20:01:03	-4.80262	-12.37138	2983	170	2.4	-4.803	-12.3713331	2980	pillow lava, unsedimented
20:01:40	-4.80262	-12.37138	2982	170	3.3	-4.803	-12.3713331	2978	Crab
20:02:25	-4.80267	-12.37142	2980	170	4.3	-4.803	-12.3713331	2975	pillow lava, unsedimented
20:03:02	-4.80263	-12.37142	2981	295	2.7	-4.803	-12.3713331	2972	HD OFF
20:05:15	-4.80262	-12.37143	2980	117	5.8	-4.803	-12.3713331	2972	moving east
20:05:21	-4.80265	-12.37142	2980	118	5.6	-4.803	-12.3713331	2972	pillow lava, unsedimented
20:06:07	-4.80267	-12.37137	2979	118	3.5	-4.803	-12.3713331	2976	actinien, snow abundand
20:06:13	-4.80263	-12.37137	2979	118	3.2	-4.803	-12.3713331	2981	HD ON

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
20:06:42	-4.80265	-12.37137	2978	130	4.1	-4.803	-12.3713331	2976	mussel bed
20:06:57	-4.80268	-12.37133	2978	130	3.5	-4.803	-12.3713331	2974	entering Golden Valley
20:08:46	-4.80270	-12.37138	2979	161	2.3	-4.803	-12.3713331	2975	flying along fissure
20:09:37	-4.80273	-12.37135	2978	121	4.2	-4.803	-12.3713331	2979	sight limited by snow and foggy waters
20:11:27	-4.80275	-12.37135	2984	40	3.0	-4.803	-12.3713331	2972	mussel bed
20:11:57	-4.80278	-12.37135	2984	51	3.1	-4.803	-12.3713331	2977	shimmring water
20:13:26	-4.80275	-12.37135	2985	30	3.3	-4.803	-12.3713331	2968	bacterial mats
20:13:34	-4.80278	-12.37135	2985	30	3.4	-4.803	-12.3713331	2972	bacterial mat, large
20:14:16	-4.80278	-12.37135	2985	27	3.4	-4.803	-12.3713331	2975	small sulfide chimney
20:14:58	-4.80277	-12.37135	2986	31	2.6	-4.803	-12.3713331	2980	approaching bacterial mat
20:15:44	-4.80278	-12.37138	2986	33	2.0	-4.803	-12.3713331	2979	shimmering water
20:17:02	-4.80280	-12.37132	2986	32	1.7	-4.803	-12.3713331	2978	opening sample barrel
20:18:45	-4.80275	-12.37137	2986	33	1.9	-4.803	-12.3713331	2977	barrel open
20:20:17	-4.80277	-12.37133	2986	32	1.7	-4.803	-12.3713331	2979	preparing to sample mat covered rock (sulfide)
20:22:37	-4.80275	-12.37133	2985	20	2.9	-4.803	-12.3713331	2977	HD OFF
20:24:31	-4.80275	-12.37133	2986	40	1.5	-4.803	-12.3713331	2978	mat covered area is sulfide hill
20:28:05	-4.80273	-12.37133	2986	40	1.5	-4.803	-12.3713331	2975	sampling little chimney
20:30:14	-4.80273	-12.37133	2986	42	1.5	-4.803	-12.3713331	2977	**sample 274ROV-2**
20:30:14	-4.80273	-12.37133	2986	42	1.5	-4.803	-12.3713331	2977	sample taken
20:34:06	-4.80275	-12.37135	2986	41	1.5	-4.803	-12.3713331	2977	going for a mussel net
20:38:55	-4.80280	-12.37135	2986	41	1.5	-4.803	-12.3713331	2977	HD ON
20:39:49	-4.80275	-12.37133	2986	47	1.2	-4.803	-12.3713331	2977	sampling mussels + mat covered sulfide with net
20:43:10	-4.80280	-12.37133	2986	44	1.2	-4.803	-12.3713331	2979	too hot, net melts
20:43:33	-4.80277	-12.37133	2986	44	1.2	-4.803	-12.3713331	2977	black smoke
20:44:00	-4.80267	-12.37138	2986	44	1.2	-4.803	-12.3713331	2978	HD OFF
20:49:35	-4.80277	-12.37135	2986	45	1.2	-4.803	-12.3713331	2980	preparing for mussel sampling
20:54:25	-4.80275	-12.37130	2987	44	1.2	-4.803	-12.3713331	2979	smoke emerging from new opening shows bubbles
21:00:20	-4.80270	-12.37133	2987	54	1.1	-4.803	-12.3713331	2980	**sample 274ROV-3**
21:00:20	-4.80270	-12.37133	2987	54	1.1	-4.803	-12.3713331	2980	taking mussel sample
21:00:42	-4.80273	-12.37132	2987	53	1.1	-4.803	-12.3713331	2977	HD ON
21:01:56	-4.80275	-12.37132	2987	57	0.8	-4.803	-12.3713331	2979	black smoke from where mussels were taken
21:05:59	-4.80275	-12.37132	2987	55	1.0	-4.803	-12.3713331	2979	additional mussels
21:08:24	-4.80278	-12.37138	2987	57	1.0	-4.803	-12.3713331	2975	mussels into barrel
21:10:28	-4.80273	-12.37137	2987	57	1.0	-4.803	-12.3713331	2977	barrel closed
21:12:13	-4.80272	-12.37133	2987	52	2.2	-4.803	-12.3713331	2977	trying to sample stone/mussels with rickmaster
21:13:20	-4.80277	-12.37132	2987	53	1.0	-4.803	-12.3713331	2979	putting it on the porch
21:14:44	-4.80277	-12.37133	2987	52	1.0	-4.803	-12.3713331	2976	**sample 274ROV-4**
21:15:38	-4.80273	-12.37133	2987	53	1.0	-4.803	-12.3713331	2978	HD OFF
21:17:00	-4.80277	-12.37130	2987	53	1.0	-4.803	-12.3713331	2980	samples secured on porch
21:17:48	-4.80275	-12.37132	2984	41	3.5	-4.803	-12.3713331	2977	leaving bottom
21:20:19	-4.80260	-12.37142	2911	344	34.7	-4.803	-12.3713331	2976	OFF THE BOTTOM
22:58:45	0.00000	0.00000	19	--	--	-4.8035002	-12.3710003	2972	ON DECK

Cruise: MAR SOUTH V
Date: 18.04.2009
Station: M78-2_281ROV
Targets: Turtle Pits

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:11:55	-4.80982	-12.37508	901	309	34.7	-4.8101668	-12.3743334	2972	IN THE WATER
17:46:19	-4.81028	-12.37363	2399	308	34.7	-4.8101668	-12.3734999	2972	ROV at 2400m, going down, no problems
17:46:57	-4.81032	-12.37367	2428	309	34.7	-4.8103328	-12.3734999	2971	try to stay west of the pits fracture and than to find our way towrds the smokers
17:54:59	-4.81017	-12.37395	2749	308	34.7	-4.8101668	-12.3734999	2971	ROV at 2750m, desending without problems, white balanced cameras, checked video overlay
17:58:37	-4.81003	-12.37403	2898	309	34.7	-4.8101668	-12.3734999	2970	ROV at 2900m
17:59:55	-4.81005	-12.37407	2954	308	33.6	-4.8103328	-12.3734999	2973	altimeter kicks in
18:00:45	-4.81002	-12.37405	2980	12	10.4	-4.8103328	-12.3734999	2973	AT THE BOTTOM
18:00:56	-4.80995	-12.37412	2984	15	6.2	-4.8101668	-12.3734999	2971	sheet flow, slightly sedimented
18:02:02	-4.81005	-12.37402	2985	34	5.5	-4.8103328	-12.3734999	2970	touch down in sedimented sheet flows, whirls
18:03:00	-4.81002	-12.37402	2986	37	4	-4.8103328	-12.3734999	2971	will start mowing towards NE, trying to locate One Boat or other smoker
18:03:13	-4.80998	-12.37402	2986	54	3.9	-4.8103328	-12.3734999	2971	sheet flow, slightly sedimented
18:03:44	-4.80997	-12.37398	2987	55	3	-4.8101668	-12.3734999	2971	jumbled lava
18:05:06	-4.80995	-12.37395	2985	60	4.2	-4.8103328	-12.3734999	2971	jumbled lava
18:05:53	-4.80995	-12.37392	2984	60	4.1	-4.8101668	-12.3734999	2972	tectonic movement causing disruption of the flows, alternating with sheet flows
18:08:13	-4.80992	-12.37390	2986	93	3.1	-4.8101668	-12.3734999	2968	sheet flow, slightly sedimented
18:09:35	-4.80987	-12.37387	2986	93	3.1	-4.8103328	-12.3734999	2969	sheet flow, slightly sedimented
18:09:47	-4.80987	-12.37387	2986	93	3.1	-4.8103328	-12.3734999	2972	small clams
18:10:05	-4.80988	-12.37382	2985	93	3.2	-4.8103328	-12.3734999	2971	tectonized lava ahead, increasing clams
18:24:06	-4.80992	-12.37377	2986	85	2.2	-4.8103328	-12.3734999	2975	at base of Southern Tower
18:25:52	-4.80997	-12.37372	2986	74	2.3	-4.8103328	-12.3734999	2971	HD ON
18:29:02	-4.80995	-12.37368	2981	18	8.3	-4.8103328	-12.3734999	2970	HD OFF
18:30:48	-4.80992	-12.37372	2984	4	6.3	-4.8101668	-12.3734999	2971	HD ON
18:35:03	-4.80992	-12.37367	2990	30	1.7	-4.8103328	-12.3734999	2971	Southern Tower is approx. 9m high, which is similat to last year, but new growth is evident
18:35:26	-4.80995	-12.37370	2990	30	1.5	-4.8101668	-12.3734999	2971	at the base of ST, looking for sweet spot for sampling
18:38:18	-4.81000	-12.37367	2983	130	6.5	-4.8103328	-12.3734999	2971	out of the pit, jumbled flows
18:38:29	-4.80997	-12.37368	2983	129	6.9	-4.8103328	-12.3734999	2970	turning south towrds One Boat
18:41:19	-4.81002	-12.37367	2983	191	4	-4.8101668	-12.3734999	2970	HD ON
18:44:07	-4.81000	-12.37370	2984	59	4.3	-4.8101668	-12.3734999	2970	One Boat ahead, size increased substantially
18:47:53	-4.81005	-12.37368	2982	23	7.1	-4.8101668	-12.3734999	2971	HD OFF
18:50:11	-4.81000	-12.37372	2981	12	6.9	-4.8101668	-12.3734999	2970	very powerful smoker near the top, bubbles
19:01:44	-4.81003	-12.37368	2981	12	7.2	-4.8103328	-12.3734999	2971	trying to take a temperature reading at this intense smoker, lokks like hell
19:02:00	-4.81000	-12.37370	2981	12	7.2	-4.8101668	-12.3734999	2970	taking KIPS nossle in Orion arm
19:02:30	-4.81002	-12.37368	2981	12	7.2	-4.8101668	-12.3734999	2972	HD ON
19:03:32	-4.81002	-12.37367	2981	12	7.2	-4.8101668	-12.3734999	2970	HD OFF
19:07:26	-4.81000	-12.37370	2981	14	7.2	-4.8101668	-12.3734999	2972	temperature probe in the smoke got 250°C
19:08:56	-4.81003	-12.37372	2980	15	7.9	-4.8103328	-12.3734999	2971	reposition, lost position
19:09:13	-4.81002	-12.37372	2981	15	7.6	-4.8101668	-12.3734999	2972	new approach towards smoker
19:13:02	-4.81002	-12.37370	2981	10	7.5	-4.8103328	-12.3734999	2971	reposition again, difficult angle to fly in smoke all around
19:14:37	-4.81003	-12.37368	2981	10	8.7	-4.8101668	-12.3734999	2971	approching smoker with KIPS,404!, 425°,
19:17:24	-4.81002	-12.37368	2981	10	7.5	-4.8101668	-12.3734999	2970	temp at 405-407°C
19:21:21	-4.81003	-12.37368	2981	10	7.5	-4.8103328	-12.3734999	2972	pump is on and was stopped, we try the lower orifice near the base
19:22:07	-4.81003	-12.37368	2981	10	7.4	-4.8103328	-12.3734999	2970	stopped the record and willmove down
19:28:11	-4.81002	-12.37370	2984	121	2.7	-4.8101668	-12.3734999	2971	HD ON
19:28:15	-4.81002	-12.37373	2984	121	2.4	-4.8101668	-12.3734999	2971	aiming for the small smoker at the base of One Boat
19:29:36	-4.80998	-12.37363	2985	209	1.4	-4.8101668	-12.3734999	2970	HD OFF
19:30:52	-4.81000	-12.37370	2985	209	1.4	-4.8103328	-12.3734999	2973	HD of the small smoker at the base
19:30:55	-4.81000	-12.37368	2985	209	1.6	-4.8101668	-12.3734999	2973	
19:30:56	-4.81000	-12.37368	2985	209	1.6	-4.8101668	-12.3734999	2973	
19:40:33	-4.80998	-12.37370	2985	209	1.3	-4.8101668	-12.3734999	2971	HD ON
19:40:40	-4.80998	-12.37370	2985	209	1.3	-4.8101668	-12.3734999	2971	245°C, and slightly rising
19:41:27	-4.81000	-12.37368	2985	209	1.3	-4.8101668	-12.3734999	2971	we take two KIPS bottles here, temp below 300°C, smoker is drawing sewater from around (talus pile)
19:41:52	-4.81003	-12.37370	2985	209	1.3	-4.8101668	-12.3734999	2971	pump on
19:42:10	-4.81000	-12.37368	2985	209	1.3	-4.8101668	-12.3734999	2970	HD OFF
19:43:59	-4.81000	-12.37370	2985	209	1.4	-4.8101668	-12.3734999	2972	**sample_281ROV-1**
19:44:16	-4.81002	-12.37367	2985	209	1.4	-4.8101668	-12.3734999	2972	small sulfide bottle taken
19:44:39	-4.81000	-12.37368	2985	209	1.4	-4.8101668	-12.3734999	2971	KIPS ON
19:44:42	-4.81000	-12.37368	2985	209	1.4	-4.8101668	-12.3734999	2971	**sample_281ROV-2**
19:44:54	-4.81000	-12.37370	2985	209	1.4	-4.8101668	-12.3734999	2971	KIPS OFF
19:48:29	-4.81003	-12.37385	2985	209	1.3	-4.8101668	-12.3734999	2971	nossel blocked (likely)
19:48:57	-4.81000	-12.37367	2985	209	1.3	-4.8101668	-12.3734999	2972	stowing the KIPS nossle before moving back to ST
19:51:56	-4.81000	-12.37372	2987	21	2.1	-4.8103328	-12.3734999	2972	ST in sight
19:55:57	-4.80993	-12.37372	2989	349	2.6	-4.8103328	-12.3734999	2971	at base of ST, weak smoker activity (although very black)
20:03:37	-4.80993	-12.37375	2982	61	5.9	-4.8101668	-12.3734999	2972	on western side of ST,too much smoker for sampling, we are in the cloud
20:07:18	-4.80992	-12.37377	2984	68	4.2	-4.8103328	-12.3734999	2971	trying to relocate to two boats, southern side
20:07:23	-4.80992	-12.37377	2983	68	4.4	-4.8101668	-12.3734999	2970	pilot change
20:14:27	-4.80990	-12.37375	2984	87	3	-4.8103328	-12.3734999	2973	HD OFF

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
20:17:55	-4.80988	-12.37375	2984	112	2.1	-4.8101668	-12.3734999	2970	preparing Rigmaster in order to open orifice at base of TB
20:17:58	-4.80988	-12.37375	2984	111	2.1	-4.8103328	-12.3734999	2969	**sample_281ROV-3**
20:19:24	-4.80988	-12.37373	2984	116	2.1	-4.8101668	-12.3734999	2970	sulfide sample from chimney at base, but sample lost, return to smoker for flid sampling
20:33:15	-4.80992	-12.37373	2983	79	3.3	-4.8101668	-12.3734999	2972	HD ON
20:36:18	-4.80990	-12.37375	2983	70	2.1	-4.8103328	-12.3734999	2969	HD run of western side of TB
20:45:52	-4.80988	-12.37375	2983	95	3.7	-4.8101668	-12.3734999	2969	now at SW side of TB, trying to open orifice for sampling
20:59:35	-4.80990	-12.37372	2985	75	0.6	-4.8101668	-12.3734999	2971	HD OFF
21:00:22	-4.80990	-12.37373	2985	74	0.8	-4.8101668	-12.3734999	2967	HD ON
21:04:02	-4.80987	-12.37373	2983	96	3.6	-4.8101668	-12.3734999	2968	HD OFF
21:09:16	-4.80990	-12.37372	2983	96	3.6	-4.8101668	-12.3734999	2972	sampling is impossible at this structure because of intense but diffuse smoke from below,
21:13:05	-4.80997	-12.37373	2984	165	5.7	-4.8103328	-12.3734999	2972	descision to move to One Boat and try fluid sampling there
21:13:21	-4.80998	-12.37372	2984	170	6.3	-4.8101668	-12.3734999	2971	arrived at base of OB,mound with anhydrite?
21:15:13	-4.81003	-12.37373	2982	73	5.9	-4.8103328	-12.3734999	2968	HD ON
21:16:28	-4.81003	-12.37368	2981	24	9	-4.8103328	-12.3734999	2971	moving alongside OB
21:16:41	-4.81002	-12.37370	2981	23	8.1	-4.8101668	-12.3734999	2970	near top,most intense smoker again in sight
21:17:16	-4.81002	-12.37370	2981	26	8	-4.8101668	-12.3734999	2970	HD OFF
21:30:04	-4.80998	-12.37372	2982	--	--	-4.8101668	-12.3734999	2969	Rigmaster fixed on larger bee-hive to the left of "boiling orifice", still aiming to collect Ti-major
21:43:41	-4.80665	-12.37402	2982	--	--	-4.8103328	-12.3734999	2971	Taking Ti-major # D1
21:57:09	-4.81017	-12.37370	2982	21	6.9	-4.8103328	-12.3734999	2971	**sample_281ROV-4**
21:57:52	-4.81017	-12.37370	2982	--	--	-4.8103328	-12.3734999	2970	hot fluid collected with Ti-major D1
22:04:55	-4.81000	-12.37370	2982	21	6.4	-4.8103328	-12.3734999	2972	taking Ti-major #D2 in order to collect a second fluid sample from same site
22:14:50	-4.81012	-12.37373	2982	--	--	-4.8103328	-12.3734999	2970	spring opens rather slowly, keep pushing the trigger
22:19:53	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2969	**sample_281ROV-5**
22:22:49	-4.81012	-12.37373	2982	--	--	-4.8103328	-12.3734999	2971	both Ti-majors now on porch
22:26:33	-4.81012	-12.37373	2982	--	--	-4.8103328	-12.3734999	2972	taking He sampler
22:33:57	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2970	positionin He sampler over boiling vent
22:37:01	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2970	moving Rigmaster in order to grab He sampler
22:44:08	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2969	Rigmaster grabs He sampler at its top
22:58:07	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2971	difficulties in pushing the trigger, need to regrab the He sampler
23:02:47	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2970	He sampler was turned, but still difficulties in pushing the trigger
23:03:55	-4.81012	-12.37373	2982	--	--	-4.8103328	-12.3734999	2971	**sample_281ROV-6**
23:04:01	-4.81012	-12.37373	2982	--	--	-4.8101668	-12.3734999	2971	end of sampling, stowing away He sampler
23:08:23	-4.81012	-12.37373	2982	--	--	-4.8103328	-12.3734999	2971	moving away from smoker, end of sampling
23:14:51	-4.81000	-12.37375	2988	21	0.3	-4.8101668	-12.3734999	2970	stowing Ti majors into sample box
23:20:26	-4.80997	-12.37373	2988	21	0.3	-4.8103328	-12.3734999	2971	off bottom
23:21:11	-4.81000	-12.37373	2988	21	0.3	-4.8103328	-12.3734999	2971	OFF THE BOTTOM
00:46:50	0.00000	0.00000	9	--	--	-4.8103328	-12.373333	2971	ON DECK

Cruise: MAR SOUTH V
Date: 19.04.2009
Station: M78-2_287ROV
Targets: Golden Valley, Foggy Corner

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
14:54:56	-4.80195	-12.37297	371	304	36	-4.8023329	-12.3719997	2979	IN THE WATER
15:46:28	-4.80250	-12.37162	2625	123	36	-4.803	-12.3706675	2966	ROV at 2700m, descending, slight noise in the HD camera
15:53:16	-4.80257	-12.37157	2899	135	36	-4.8028331	-12.3706675	2971	ROV at 2900m
15:55:11	-4.80255	-12.37150	2969	135	19.2	-4.803	-12.3706675	2972	altimeter kicks in, 30m above ground
15:55:51	-4.80255	-12.37150	2981	134	7.3	-4.803	-12.3706675	2973	AT THE BOTTOM
15:56:32	-4.80253	-12.37148	2981	135	6.1	-4.803	-12.3706675	2969	at bottom in slightly sedimented pillows. we are NW of Golden Valley
15:58:19	-4.80255	-12.37137	2981	134	7.1	-4.803	-12.3706675	2973	on our way to SE towards GV
16:02:29	-4.80265	-12.37132	2987	150	2.6	-4.803	-12.3706675	2970	heading 150 to find GV
16:11:51	-4.80270	-12.37122	2986	172	3	-4.803	-12.3706675	2971	at Foggy Corner, fish, cloudy water, mussel patches
16:12:17	-4.80275	-12.37123	2987	156	3.1	-4.8028331	-12.3706675	2972	trying to locate good spot for Niskin plume sample
16:15:04	-4.80277	-12.37130	2986	83	3.4	-4.8028331	-12.3706675	2968	shimmering water ? between pillows
16:16:56	-4.80275	-12.37127	2987	74	2.4	-4.803	-12.3706675	2968	prepare to take Niskin sample
16:17:29	-4.80278	-12.37128	2987	74	2.4	-4.803	-12.3706675	2967	HD ON
16:17:44	-4.80277	-12.37130	2987	74	2.4	-4.803	-12.3706675	2966	**took niskin bottle 287ROV-1**
16:18:54	-4.80275	-12.37133	2987	75	2.4	-4.803	-12.3706675	2970	HD OFF
16:20:46	-4.80272	-12.37133	2986	359	3.1	-4.803	-12.3706675	2970	HD ON
16:22:07	-4.80268	-12.37130	2986	292	3.4	-4.8028331	-12.3706675	2975	HD OFF
16:23:11	-4.80273	-12.37130	2986	250	3.1	-4.803	-12.3706675	2972	heading towards WSW trying to find clueless
16:23:23	-4.80277	-12.37128	2987	256	2.6	-4.803	-12.3706675	2971	fish
16:23:26	-4.80277	-12.37128	2987	255	2.4	-4.803	-12.3706675	2971	fish
16:24:06	-4.80277	-12.37127	2988	252	2.2	-4.8028331	-12.3706675	2968	pillow lava, slightly sedimented
16:24:24	-4.80277	-12.37138	2988	251	2.2	-4.8028331	-12.3706675	2968	fish
16:24:37	-4.80278	-12.37137	2989	252	1.8	-4.8028331	-12.3706675	2973	pillow lava, slightly sedimented
16:25:21	-4.80277	-12.37138	2990	247	2.7	-4.8028331	-12.3706675	2973	pillow lava, slightly sedimented
16:25:54	-4.80282	-12.37135	2991	248	2.7	-4.8028331	-12.3706675	2970	some lobate flows with sediment in interstices
16:27:48	-4.80288	-12.37143	2992	254	2.1	-4.8028331	-12.3706675	2973	HD ON
16:28:40	-4.80282	-12.37147	2991	254	3.5	-4.803	-12.3706675	2971	HD OFF
16:29:06	-4.80283	-12.37147	2992	253	3.7	-4.803	-12.3706675	2971	lobate flow, slightly sedimented
16:31:02	-4.80290	-12.37152	2993	243	3	-4.803	-12.3706675	2971	tectonized lava, with drainage features
16:34:02	-4.80287	-12.37155	2992	197	3.1	-4.803	-12.3706675	2972	highly tectonized lava
16:34:37	-4.80280	-12.37150	2993	180	3	-4.8028331	-12.3706675	2970	turning south, trying to locate clueless
16:35:54	-4.80295	-12.37153	2994	171	1.9	-4.803	-12.3706675	2969	HD ON
16:36:24	-4.80290	-12.37158	2995	171	2	-4.8028331	-12.3706675	2972	Octopus
16:36:47	-4.80297	-12.37152	2995	173	1.8	-4.8028331	-12.3706675	2973	HD OFF
16:41:54	-4.80298	-12.37150	2994	189	2.5	-4.8028331	-12.3706675	2966	contact between jumbled flow and sheet flow
16:50:48	-4.80307	-12.37140	2991	34	4.1	-4.8028331	-12.3706675	2973	tectonized lava with pillars
16:51:14	-4.80300	-12.37145	2991	34	4	-4.803	-12.3706675	2969	in pillows with white patches
16:51:19	-4.80300	-12.37145	2991	33	4	-4.803	-12.3706675	2969	inactive chiney
16:55:00	-4.80298	-12.37143	2992	330	3.4	-4.803	-12.3706675	2970	turning 360° to look around
16:58:47	-4.80297	-12.37138	2994	285	1.7	-4.803	-12.3706675	2972	sitting in drainage feature
16:58:54	-4.80298	-12.37145	2994	284	1.7	-4.803	-12.3706675	2971	HD ON
16:59:54	-4.80303	-12.37145	2994	283	1.7	-4.803	-12.3706675	2969	HD OFF
17:02:23	-4.80298	-12.37138	2992	273	3	-4.8028331	-12.3706675	2968	HD ON
17:02:36	-4.80297	-12.37140	2992	273	3.5	-4.8028331	-12.3706675	2974	sitting near diffuse fluid flow, few mussles
17:07:08	-4.80297	-12.37135	2991	104	3.5	-4.803	-12.3706675	2968	we are at Sisters Peak !
17:07:14	-4.80298	-12.37138	2991	104	3.5	-4.803	-12.3706675	2968	abundant sulfide talus
17:11:54	-4.80292	-12.37140	2987	217	8.1	-4.803	-12.3706675	2971	Sisters Peak ahead, we drive towards NNW
17:12:38	-4.80335	-12.37047	2991	322	4.4	-4.803	-12.3706675	2969	pillow lava, slightly sedimented
17:13:04	-4.80385	-12.37480	2993	327	2.5	-4.803	-12.3706675	2969	heading 330 and GO
17:14:36	-4.80280	-12.37140	2991	328	2.6	-4.803	-12.3706675	2969	HD ON
17:16:07	-4.80270	-12.37147	2986	328	2.7	-4.8028331	-12.3706675	2971	HD OFF
17:20:44	-4.80288	-12.37145	2993	178	3	-4.803	-12.3706675	2969	pillow lava, slightly sedimented
17:20:49	-4.80288	-12.37145	2992	176	3.3	-4.803	-12.3706675	2969	collapse pit
17:21:30	-4.80292	-12.37145	2993	182	2.9	-4.803	-12.3706675	2971	fissure
17:21:33	-4.80292	-12.37145	2993	182	3	-4.803	-12.3706675	2971	lava pillar
17:23:29	-4.80292	-12.37152	2993	264	2.6	-4.803	-12.3706675	2978	back at Sisters Peak (diffuse patch)
17:23:44	-4.80295	-12.37150	2994	271	2.4	-4.803	-12.3706675	2975	heading west in order to find fissure to the west
17:24:14	-4.80298	-12.37155	2994	272	2.3	-4.803	-12.3708334	2972	hackly lava
17:26:03	-4.80297	-12.37178	2994	272	2.5	-4.8028331	-12.3710003	2972	sheet flow, slightly sedimented
17:27:04	-4.80295	-12.37190	2995	272	2.6	-4.8028331	-12.3710003	2967	contact sheet flow (small width) to pillows
17:28:10	-4.80298	-12.37203	2996	272	2.2	-4.803	-12.3711672	2975	sheet flow, slightly sedimented
17:31:19	-4.80305	-12.37230	2996	272	2.3	-4.803	-12.3715	2975	jumbled lava
17:36:26	-4.80295	-12.37235	2997	40	1.8	-4.8028331	-12.3715	2978	sheet flow, slightly sedimented
17:36:31	-4.80295	-12.37235	2997	32	1.8	-4.8028331	-12.3715	2979	on hackly lava, following to the NW
17:37:16	-4.80293	-12.37232	2998	31	1.9	-4.8028331	-12.3715	2976	sheet flow, slightly sedimented
17:37:58	-4.80192	-12.36905	2997	31	1.8	-4.803	-12.3715	2978	jumbled lava
17:38:51	-4.80287	-12.37232	2996	31	2.2	-4.8028331	-12.3715	2977	pilot change
17:45:40	-4.80287	-12.37233	2996	89	2.2	-4.8028331	-12.3715	2977	at the southern contact between pillow mound and sheet flows in the valley
17:47:58	-4.80287	-12.37228	2996	89	1.5	-4.803	-12.3715	2976	flying along this contact to the east
17:48:03	-4.80287	-12.37228	2995	88	1.7	-4.8028331	-12.3715	2976	pillow lava, slightly sedimented
17:50:37	-4.80283	-12.37225	2995	98	2.5	-4.803	-12.3715	2972	pillow lava, slightly sedimented
17:50:40	-4.80283	-12.37225	2995	98	2.4	-4.803	-12.3715	2972	collapse pit
17:52:09	-4.80285	-12.37217	2996	95	2.1	-4.803	-12.3715	2974	tectonics in sheet flow, lava drainage
17:54:41	-4.80288	-12.37207	2994	167	2.4	-4.803	-12.3713331	2975	lobate flows with collapsed roofs
17:54:57	-4.80272	-12.37222	2995	180	2.4	-4.803	-12.3713331	2974	turned south for 10 m, lobate flows with few skiylights

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:55:41	-4.80292	-12.37207	2994	180	2.2	-4.803	-12.3713331	2980	jumbled lava
17:55:45	-4.80292	-12.37207	2994	180	2.2	-4.803	-12.3713331	2980	fault
17:59:44	-4.80297	-12.37188	2994	89	2.3	-4.803	-12.3713331	2977	still image
18:03:01	-4.80295	-12.37193	2994	341	2.3	-4.803	-12.3713331	2978	large collapse pit ahead, this belongs to the large fissure
18:03:08	-4.80300	-12.37188	2994	341	2.4	-4.803	-12.3713331	2976	HD ON
18:06:57	-4.80300	-12.37193	2994	180	2.4	-4.803	-12.3713331	2977	moving south through tectonized lava
18:11:05	-4.80312	-12.37192	2994	312	2.2	-4.803	-12.3713331	2976	stopped at contact to pillows, no idea where we are!
18:11:34	-4.80310	-12.37195	2993	27	2.3	-4.803	-12.3713331	2978	turning to NNE
18:13:22	-4.80307	-12.37188	2994	24	2.2	-4.8031669	-12.3713331	2975	jumbled lava
18:19:01	-4.80293	-12.37185	2984	49	3	-4.8033328	-12.3713331	2973	fish
18:19:11	-4.80288	-12.37185	2985	59	2.9	-4.8033328	-12.3713331	2976	pillow lava, unsedimented
18:19:21	-4.80288	-12.37185	2984	61	2.7	-4.8033328	-12.3713331	2975	on the mound
18:19:52	-4.80287	-12.37187	2982	61	3	-4.8033328	-12.3713331	2975	pillow lava, fresh lustreous
18:19:58	-4.80277	-12.37180	2982	60	3.1	-4.8033328	-12.3713331	2976	HD OFF
18:20:42	-4.80278	-12.37177	2981	61	2.6	-4.8033328	-12.3713331	2975	near top of mound going downhill
18:20:46	-4.80278	-12.37177	2982	61	2.3	-4.8033328	-12.3713331	2975	pillow lava, unsedimented
18:34:42	-4.80267	-12.37130	2984	92	2.6	-4.803	-12.3710003	2970	choose to fly to GV instead
18:35:02	-4.80270	-12.37130	2984	92	2.2	-4.803	-12.3710003	2970	on unsedimented pillow near base of mound
18:35:54	-4.80268	-12.37127	2983	92	2.1	-4.803	-12.3710003	2974	still image
18:36:22	-4.80268	-12.37125	2983	92	2.2	-4.803	-12.3710003	2974	skylight in pillow lava
18:36:40	-4.80265	-12.37125	2984	92	1.5	-4.803	-12.3710003	2977	milky water
18:36:56	-4.80263	-12.37120	2983	92	1.5	-4.803	-12.3710003	2976	Actinaria
18:36:58	-4.80267	-12.37122	2983	92	1.5	-4.803	-12.3710003	2974	Actinaria
18:37:26	-4.80265	-12.37120	2984	90	1	-4.803	-12.3710003	2973	close to Foggy Corner
18:37:35	-4.80267	-12.37120	2983	98	1.3	-4.803	-12.3710003	2970	lobate flows partly hollow
18:38:09	-4.80267	-12.37118	2983	90	1.7	-4.803	-12.3710003	2974	slightly uphill, lobate flows
18:38:30	-4.80268	-12.37117	2982	91	1.8	-4.803	-12.3710003	2976	still image
18:38:38	-4.80267	-12.37117	2982	91	2.1	-4.803	-12.3710003	2974	pillow lava, unsedimented
18:38:58	-4.80270	-12.37112	2980	90	4	-4.803	-12.3710003	2979	pillow lava, unsedimented
18:39:28	-4.80267	-12.37113	2979	92	2.5	-4.803	-12.3710003	2979	HD ON
18:39:35	-4.80267	-12.37113	2978	95	2.3	-4.803	-12.3710003	2975	still image
18:40:17	-4.80265	-12.37107	2977	83	1.3	-4.803	-12.3710003	2971	tectonized lava
18:41:17	-4.80262	-12.37100	2976	96	2.2	-4.803	-12.3710003	2977	Gorgonia
18:41:23	-4.80260	-12.37098	2976	100	1.9	-4.803	-12.3710003	2977	pillow lava, unsedimented
18:41:48	-4.80267	-12.37098	2978	111	0.7	-4.803	-12.3710003	2974	pillow lava, unsedimented
18:42:02	-4.80263	-12.37098	2977	110	2.1	-4.803	-12.3710003	2973	fissure ahead on sonar
18:42:53	-4.80263	-12.37093	2977	107	3.9	-4.803	-12.3710003	2974	going downhill fissure 10 m ahead
18:44:59	-4.80267	-12.37075	2984	95	1.9	-4.803	-12.3708334	2970	sheet flow, sedimented slightly
18:45:05	-4.80267	-12.37075	2984	94	2.3	-4.803	-12.3708334	2974	fissure ahead
18:47:30	-4.80267	-12.37058	2983	175	4.6	-4.803	-12.3704996	2970	fissure
18:50:59	-4.80275	-12.37057	2984	181	4.2	-4.803	-12.3704996	2971	Gorgonia
18:52:01	-4.80277	-12.37055	2983	148	2.3	-4.803	-12.3704996	2971	likely came too far south, turning northward
18:52:17	-4.80275	-12.37050	2983	108	2.3	-4.803	-12.3704996	2968	HD OFF
18:53:46	-4.80272	-12.37053	2985	28	1.5	-4.803	-12.3704996	2969	still image
18:58:37	-4.80253	-12.37038	2989	303	2.7	-4.8031669	-12.3701668	2971	fissure in sheet flow
19:01:53	-4.80267	-12.37040	2981	261	2.9	-4.8031669	-12.3699999	2971	HD ON
19:02:25	-4.80265	-12.37045	2980	242	2.5	-4.8031669	-12.3699999	2968	pillow lava, unsedimented
19:08:43	-4.80267	-12.37050	2975	272	2.7	-4.8031669	-12.3699999	2969	HD OFF
19:11:34	-4.80278	-12.37070	2980	277	3.8	-4.8031669	-12.3699999	2974	pillow lava, slightly sedimented
19:14:41	-4.80283	-12.37082	2983	261	3.4	-4.8031669	-12.3699999	2969	huge very deep fissure
19:16:37	-4.80282	-12.37080	2985	270	1.1	-4.8031669	-12.3699999	2968	HD ON
19:19:53	-4.80285	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2970	searching for diffuse fluid site surrounded by mussels
19:21:39	-4.80285	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2968	found nice diffuse fluid site with fluids emanating from a crack in rocks
19:22:10	-4.80285	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2965	HD OFF
19:22:49	-4.80278	-12.37082	2987	336	0.7	-4.8031669	-12.3699999	2970	searching for a spot to position the diefast
19:24:13	-4.80277	-12.37083	2987	336	0.7	-4.8033328	-12.3699999	2970	we are not sure which site this is (Foggy corner?????)
19:28:11	-4.80282	-12.37085	2987	336	0.7	-4.8031669	-12.3699999	2968	still positioning die fast
19:33:29	-4.80280	-12.37082	2987	335	0.8	-4.8031669	-12.3699999	2970	measuring temperature with the kips nozzle at the diffuse outflow
19:34:08	-4.80280	-12.37087	2987	336	0.8	-4.8031669	-12.3699999	2970	grabbing the kips nozzle
19:34:19	-4.80280	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2970	HD ON
19:34:58	-4.80280	-12.37087	2987	336	0.8	-4.8031669	-12.3699999	2966	HD OFF
19:41:27	-4.80278	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2969	**pump on t is 7°C; KIPS A1 (287 ROV 2)Schwefel Fixierung**
19:43:42	-4.80287	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2969	
19:50:46	-4.80253	-12.37070	2987	336	0.8	-4.8031669	-12.3699999	2968	HD ON
19:51:10	-4.80280	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2968	HD OFF
19:51:22	-4.80280	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2968	dosierpum off
19:51:47	-4.80280	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2968	KIPS ON
19:51:51	-4.80280	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2968	**287 ROV 3 (KIPS A2)**
19:53:47	-4.80280	-12.37087	2987	336	0.8	-4.8031669	-12.3699999	2968	t = 5.5°C
19:57:03	-4.80282	-12.37087	2987	338	0.9	-4.8031669	-12.3699999	2968	KIPS OFF
19:57:04	-4.80282	-12.37087	2987	338	0.9	-4.8031669	-12.3699999	2969	KIPS OFF
19:58:13	-4.80280	-12.37085	2987	335	0.7	-4.8031669	-12.3699999	2973	repositioning the arm bc ship moved
20:00:04	-4.80282	-12.37085	2987	335	0.8	-4.8031669	-12.3699999	2967	KIPS ON
20:00:06	-4.80282	-12.37085	2987	335	0.8	-4.8031669	-12.3699999	2967	**287 ROV 4 (KIPS A3)**
20:00:32	-4.80280	-12.37083	2987	335	0.9	-4.8031669	-12.3699999	2972	7.5°C
20:03:10	-4.80282	-12.37082	2987	337	0.8	-4.8031669	-12.3699999	2967	HD ON
20:03:34	-4.80282	-12.37085	2987	337	0.8	-4.8031669	-12.3699999	2969	shrimps grazing on microbe mats (?)
20:04:03	-4.80280	-12.37083	2987	337	0.8	-4.8031669	-12.3699999	2973	HD OFF
20:05:19	-4.80280	-12.37085	2987	336	0.8	-4.8033328	-12.3699999	2968	KIPS OFF
20:05:44	-4.80277	-12.37090	2987	336	0.8	-4.8031669	-12.3699999	2970	**287 ROV 5 (KIPS B4)**
20:05:45	-4.80277	-12.37090	2987	336	0.8	-4.8031669	-12.3699999	2970	KIPS ON

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
20:06:08	-4.80280	-12.37092	2987	335	0.8	-4.8031669	-12.3699999	2967	t=7°C
20:08:16	-4.80280	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2967	HD ON
20:08:29	-4.80280	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2969	close up of shrimp
20:10:35	-4.80283	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2969	HD OFF
20:10:35	-4.80283	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2969	HD OFF
20:10:46	-4.80285	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2967	KIPS OFF
20:11:11	-4.80282	-12.37083	2987	336	0.8	-4.8033328	-12.3699999	2969	KIPS ON
20:11:13	-4.80282	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2969	**287 ROV 6 (KIPS B5)**
20:11:35	-4.80282	-12.37085	2987	336	0.8	-4.8033328	-12.3699999	2969	t = 8°C
20:17:42	-4.80280	-12.37085	2987	336	0.9	-4.8033328	-12.3699999	2969	KIPS OFF
20:20:51	-4.80282	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2969	KIPS ON
20:20:52	-4.80282	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2968	**287 ROV 7 (KIPS B6)**
20:21:23	-4.80280	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2969	t = 7°C
20:26:36	-4.80280	-12.37083	2987	335	0.8	-4.8031669	-12.3699999	2970	KIPS OFF
20:26:38	-4.80280	-12.37083	2987	335	0.8	-4.8031669	-12.3699999	2970	t = 5.5°C
20:26:57	-4.80283	-12.37087	2987	336	0.8	-4.8031669	-12.3699999	2967	KIPS ON
20:27:08	-4.80282	-12.37082	2987	336	0.8	-4.8031669	-12.3699999	2968	**287 ROV 8 (KIPS C7)**
20:27:33	-4.80280	-12.37083	2987	336	0.8	-4.8031669	-12.3699999	2967	t = 7°C
20:32:29	-4.80280	-12.37088	2987	336	0.8	-4.8031669	-12.3699999	2969	KIPS OFF
20:35:13	-4.80288	-12.37078	2987	336	0.8	-4.8031669	-12.3699999	2969	KIPS ON
20:35:14	-4.80285	-12.37082	2987	336	0.8	-4.8031669	-12.3699999	2969	**287 ROV 9 (KIPS C8)**
20:36:02	-4.80282	-12.37085	2987	336	0.8	-4.8031669	-12.3699999	2968	t = 6.4°C
20:41:45	-4.80280	-12.37093	2987	336	0.7	-4.8031669	-12.3699999	2967	KIPS OFF
20:42:05	-4.80285	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2968	KIPS ON
20:42:05	-4.80285	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2968	KIPS ON
20:42:06	-4.80285	-12.37087	2987	336	0.7	-4.8031669	-12.3699999	2968	**287 ROV 10 (KIPS C9)**
20:42:42	-4.80283	-12.37088	2987	336	0.7	-4.8031669	-12.3699999	2966	t = 7.1°C
20:43:22	-4.80283	-12.37085	2987	336	0.7	-4.8031669	-12.3699999	2969	KIPS OFF
20:43:43	-4.80282	-12.37085	2987	336	0.7	-4.8031669	-12.3699999	2966	KIPS ON
20:45:21	-4.80283	-12.37083	2987	336	0.7	-4.8031669	-12.3699999	2972	KIPS OFF
20:47:15	-4.80285	-12.37090	2987	336	0.7	-4.8031669	-12.3699999	2969	KIPS ON
20:50:09	-4.80282	-12.37078	2987	336	0.7	-4.8031669	-12.3699999	2968	HD ON
20:50:10	-4.80282	-12.37078	2987	336	0.7	-4.8031669	-12.3699999	2968	HD OFF
20:52:46	-4.80288	-12.37082	2987	336	0.7	-4.8031669	-12.3699999	2968	KIPS OFF
21:00:24	-4.80283	-12.37090	2988	339	0.9	-4.8031669	-12.3699999	2970	final KIPS check of N³deld³
21:12:18	-4.80285	-12.37087	2987	342	0.9	-4.8031669	-12.3699999	2967	1. task: collect individual mussels with Orion for DIE FAST
21:14:17	-4.80278	-12.37083	2988	341	0.9	-4.8031669	-12.3699999	2966	mussels can be reached with Orion from present position
21:17:54	-4.80278	-12.37087	2987	341	0.9	-4.8031669	-12.3699999	2970	DIE FAST taken from the Rigmaster by Orion and placed on the ground
21:24:26	-4.80285	-12.37087	2988	339	1	-4.8031669	-12.3699999	2973	still image
21:24:50	-4.80287	-12.37085	2988	339	1	-4.8031669	-12.3699999	2972	still image from DIE FAST with open lit
21:25:10	-4.80283	-12.37083	2988	338	1	-4.8031669	-12.3699999	2966	collecting mussels for DIE FAST
21:30:48	-4.80280	-12.37087	2987	338	1	-4.8031669	-12.3699999	2968	difficult to collect undamaged mussels with Orion, will try to use shovel
21:34:32	-4.80297	-12.37090	2988	341	0.9	-4.8031669	-12.3699999	2968	successfully collected a few mussels with shovel
21:34:46	-4.80283	-12.37082	2987	341	0.9	-4.8033328	-12.3699999	2969	move mussels into DIE FAST
21:34:46	-4.80283	-12.37082	2987	341	0.9	-4.8033328	-12.3699999	2969	**287 ROV 11**
21:36:19	-4.80283	-12.37080	2987	340	1	-4.8031669	-12.3699999	2966	still image
21:36:20	-4.80283	-12.37080	2987	340	0.9	-4.8031669	-12.3699999	2966	still image
21:36:54	-4.80280	-12.37085	2988	340	1	-4.8031669	-12.3699999	2976	still image with shovel above DIE FAST
21:38:21	-4.80287	-12.37088	2987	342	0.9	-4.8033328	-12.3699999	2970	place shovel on porch and close lit from DIE FAST
21:39:48	-4.80280	-12.37085	2987	342	1	-4.8031669	-12.3699999	2967	still image
21:40:11	-4.80280	-12.37085	2987	342	1	-4.8031669	-12.3699999	2973	still image: DIEFAST closed
21:40:13	-4.80283	-12.37085	2987	341	0.9	-4.8031669	-12.3699999	2973	still image
21:40:39	-4.80280	-12.37083	2987	340	0.9	-4.8031669	-12.3699999	2970	still image: DIE FAST from above
21:44:55	-4.80290	-12.37087	2988	332	0.7	-4.8031669	-12.3699999	2970	opening syringes filled with formaldehyde
21:47:56	-4.80275	-12.37082	2988	333	0.7	-4.8031669	-12.3699999	2971	now opening grey sample box
21:50:13	-4.80283	-12.37085	2987	332	0.9	-4.8031669	-12.3699999	2971	HD ON
21:51:47	-4.80278	-12.37083	2987	332	0.9	-4.8031669	-12.3699999	2971	HD OFF
21:52:21	-4.80282	-12.37083	2988	332	0.8	-4.8031669	-12.3699999	2969	mussels successfully placed into grey box
21:52:21	-4.80282	-12.37083	2988	332	0.8	-4.8031669	-12.3699999	2969	**287 ROV 12**
21:52:50	-4.80280	-12.37082	2988	332	0.8	-4.8031669	-12.3699999	2967	place shovel into sample drawer, close lit of grey sample box
21:53:34	-4.80283	-12.37087	2988	333	0.9	-4.8031669	-12.3699999	2967	close sample drawer
21:58:58	-4.80287	-12.37083	2988	329	0.9	-4.8031669	-12.3699999	2978	place marker 22
22:00:43	-4.80282	-12.37087	2988	329	0.9	-4.8031669	-12.3699999	2966	place DIE FAST on porch
22:05:33	-4.80278	-12.37088	2988	327	1	-4.8031669	-12.3699999	2966	move marker 22 to its final position
22:06:27	-4.80283	-12.37085	2987	327	1.1	-4.8031669	-12.3699999	2975	still image
22:06:54	-4.80278	-12.37088	2987	327	1.3	-4.8031669	-12.3699999	2975	still image with marker
22:09:06	-4.80282	-12.37088	2987	327	1.2	-4.8031669	-12.3699999	2970	still image
22:09:21	-4.80283	-12.37087	2987	327	1.2	-4.8033328	-12.3699999	2968	still image with marker at final position
22:10:38	-4.80282	-12.37085	2986	113	2.1	-4.8031669	-12.3699999	2966	lift off, move up 2 m and turn 360° to look for marker at Foggy Corner
22:17:20	-4.80283	-12.37093	2986	323	2.4	-4.8031669	-12.3699999	2969	no marker 7 was seen
22:18:35	-4.80280	-12.37085	2973	322	13.5	-4.8031669	-12.3699999	2967	OFF THE BOTTOM
23:55:32	0.00000	0.00000	15	--	--	-4.8200002	-12.3743334	2972	ON DECK

Cruise: MAR SOUTH V
Date: 21.04.2009
Station: M78-2_297ROV
Targets: Red Lion, Sisters Peak, Golden Valley, Clueless

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
10:27:32	-4.79695	-12.37760	1114	89	0	-4.7971668	-12.3769999	3023	IN THE WATER
11:07:33	-4.79722	-12.37760	2802			-4.7973328	-12.376667	3026	collapse pit
11:08:03	-4.79723	-12.37760	2822			-4.7973328	-12.376667	3024	collapse pit
11:08:03	-4.79723	-12.37760	2823	71	0	-4.7973328	-12.376667	3024	collapse pit
11:14:43	-4.79723	-12.37728	3048	89	5.8	-4.7975001	-12.3765001	3024	AT THE BOTTOM
11:15:12	-4.79725	-12.37730	3052	89	2.3	-4.7975001	-12.3765001	3016	bottomsite, 3050m water depth
11:18:04	-4.79722	-12.37707	3054	88	3.2	-4.797667	-12.3763332	3020	sheet lava with circular sediment patches
11:18:17	-4.79720	-12.37705	3054	88	2.7	-4.797667	-12.3763332	3020	pillow lava, slightly sedimented
11:18:38	-4.79722	-12.37698	3055	88	1	-4.797667	-12.3763332	3020	heading 90°
11:18:47	-4.79722	-12.37698	3055	88	1.4	-4.797667	-12.3763332	3018	pillow lava, unsedimented
11:19:27	-4.79718	-12.37690	3053	89	2.1	-4.797667	-12.3763332	3019	bottomat water depth of 3055m
11:19:37	-4.79718	-12.37690	3053	90	2.1	-4.797667	-12.3763332	3017	
11:19:41	-4.79717	-12.37687	3053	90	2.4	-4.797667	-12.3763332	3017	pillow lava, unsedimented
11:20:49	-4.79715	-12.37672	3050	89	3.6	-4.797667	-12.3763332	3022	pillow lava, unsedimented
11:21:00	-4.79715	-12.37672	3049	90	3.5	-4.797667	-12.3763332	3018	fish
11:22:06	-4.79715	-12.37667	3048	89	3.3	-4.797667	-12.3763332	3019	pillow lava, unsedimented
11:22:31	-4.79712	-12.37663	3048	90	3.5	-4.797667	-12.3763332	3020	still flying over unsedimented older pillow lava
11:25:08	-4.79713	-12.37653	3046	135	4	-4.797667	-12.3763332	3019	heading 120° now
11:25:47	-4.79650	-12.37992	3045	160	3.7	-4.797667	-12.3763332	3018	sonar possibly showing chimney structures, turning to heading of 140°
11:25:53	-4.79710	-12.37648	3045	168	3.9	-4.797667	-12.3763332	3018	pillow lava, unsedimented
11:26:20	-4.79715	-12.37650	3046	184	2	-4.797667	-12.3761673	3020	lobate flow, unsedimented
11:26:48	-4.79723	-12.37648	3045	186	2.7	-4.797667	-12.3763332	3019	hydrothermal sediment
11:27:27	-4.79727	-12.37652	3044	159	3.2	-4.797667	-12.3763332	3019	more hydrothermal sediment in between pillows and lobate flows
11:27:44	-4.79728	-12.37648	3044	159	3.2	-4.797667	-12.3763332	3022	first chimney structure appearing
11:28:21	-4.79735	-12.37647	3043	162	3.3	-4.797667	-12.3763332	3018	Shrimp Farm ahead
11:29:37	-4.79730	-12.37645	3043	164	3.8	-4.797667	-12.3763332	3021	several smaller active smokers
11:30:01	-4.79732	-12.37643	3043	158	4	-4.797667	-12.3763332	3023	chimney has white appearance, but no shrimps visible
11:30:52	-4.79730	-12.37642	3043	202	3	-4.797667	-12.3763332	3021	on chentral part of flange is a spot with several small vents emitting black smoke
11:31:48	-4.79740	-12.37628	3042	203	3.9	-4.797667	-12.3763332	3020	white crusts on much of the flange structure
11:31:56	-4.79740	-12.37628	3042	203	3.9	-4.797667	-12.3763332	3020	still image
11:32:07	-4.79732	-12.37655	3043	203	3.6	-4.797667	-12.3763332	3020	still image from active site of structure
11:32:42	-4.79737	-12.37635	3043	203	3.6	-4.797667	-12.3763332	3026	still image
11:33:06	-4.79747	-12.37648	3043	203	3.6	-4.797667	-12.3763332	3023	looks like black smoke is coming from underneath an edge rather than individual smokers
11:33:16	-4.79747	-12.37648	3043	203	3.6	-4.797667	-12.3763332	3013	still image
11:33:23	-4.79735	-12.37650	3043	203	3.6	-4.797667	-12.3763332	3020	still image with flash
11:34:20	-4.79732	-12.37648	3042	180	4.3	-4.797667	-12.3763332	3021	searching second smoker in Red Lion vent field
11:35:25	-4.79735	-12.37645	3043	127	3.5	-4.797667	-12.3763332	3017	presumed Shrimp Farm with sulfide talus towards SE
11:38:26	-4.79738	-12.37645	3043	87	1.8	-4.797667	-12.3763332	3016	heading east, sulfide debris
11:38:50	-4.79738	-12.37575	3043	64	3	-4.797667	-12.3763332	3022	HD ON
11:39:27	-4.79742	-12.37645	3043	48	3.4	-4.797667	-12.3763332	3022	HD OFF
11:40:51	-4.79738	-12.37650	3044	346	2.7	-4.797667	-12.3763332	3020	looking north, shadow in sonar, moving there
11:43:09	-4.79742	-12.37652	3041	44	5.7	-4.797667	-12.3763332	3025	chimney, looks like Tannenbaum
11:43:11	-4.79735	-12.37657	3041	44	5.7	-4.797667	-12.3761673	3025	HD ON
11:43:29	-4.79735	-12.37653	3041	65	5.3	-4.797667	-12.3763332	3019	HD sequence from presumed Tannenbaum
11:44:49	-4.79737	-12.37657	3041	101	6.6	-4.797667	-12.3761673	3021	moving around chimney with HD on
11:45:36	-4.79738	-12.37655	3041	45	6.1	-4.797667	-12.3761673	3019	Comment: if this is Tannenbaum and we moved north before, then previous structure must have been Mephisto rather than Shrimp Farm
11:45:51	-4.79740	-12.37655	3041	37	6.2	-4.797667	-12.3761673	3021	still image
11:46:08	-4.79738	-12.37653	3041	36	6.1	-4.797667	-12.3761673	3020	still image of presumed Tannenbaum
11:46:12	-4.79738	-12.37653	3041	34	6.1	-4.797667	-12.3761673	3021	still image
11:46:20	-4.79738	-12.37653	3041	32	5.8	-4.797667	-12.3761673	3021	another stil image, same site
11:46:43	-4.79737	-12.37650	3042	25	5.4	-4.797667	-12.3761673	3025	white color in central part and on top
11:46:51	-4.79737	-12.37650	3042	23	5.4	-4.797667	-12.3761673	3021	one smoker on top
11:47:26	-4.79737	-12.37650	3041	24	6.1	-4.797667	-12.3761673	3021	white color is a crust, almost no shrimps
11:47:46	-4.79735	-12.37652	3041	22	5.4	-4.797667	-12.3761673	3018	still image
11:48:23	-4.79737	-12.37650	3041	12	5.2	-4.797667	-12.3763332	3020	still image
11:48:32	-4.79737	-12.37647	3041	12	5.2	-4.797667	-12.3763332	3020	zoomed in for another still image
11:48:54	-4.79738	-12.37655	3041	12	5	-4.797667	-12.3761673	3019	some pinkish shripms on white crust
11:49:01	-4.79740	-12.37657	3042	12	5	-4.797667	-12.3763332	3020	still image
11:49:32	-4.79738	-12.37652	3041	12	5.1	-4.797667	-12.3761673	3020	HD OFF
11:49:42	-4.79738	-12.37655	3042	6	5	-4.797667	-12.3761673	3020	HD off
11:50:10	-4.79733	-12.37653	3041	340	4.9	-4.797667	-12.3761673	3021	moving around to check out potential sampling spot for fluids
11:50:23	-4.79737	-12.37652	3041	340	5.1	-4.797667	-12.3761673	3018	HD ON
11:51:00	-4.79733	-12.37650	3042	334	4.8	-4.797667	-12.3761673	3022	very active smoker structure on top of chimney
11:51:21	-4.79733	-12.37653	3041	334	5.3	-4.797667	-12.3763332	3020	HD OFF
11:52:16	-4.79732	-12.37653	3042	328	5	-4.797667	-12.3761673	3019	search for next chimney structure, heading to the west
11:52:34	-4.79733	-12.37653	3042	282	5	-4.797667	-12.3761673	3021	shadow in sonar
11:53:03	-4.79735	-12.37655	3041	295	5.4	-4.797667	-12.3761673	3021	turned ROV looking W, chimney immediately in sight

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
11:53:45	-4.79737	-12.37658	3042	13	4.8	-4.797667	-12.3761673	3018	must be Sugerhead,because we see white flange structure in the back
11:53:57	-4.79738	-12.37657	3042	23	5.1	-4.797667	-12.3763332	3018	HD ON
11:54:09	-4.79738	-12.37658	3042	34	4.9	-4.797667	-12.3761673	3020	HD von Sugarhead
11:54:10	-4.79738	-12.37658	3042	--	--	-4.797667	-12.3761673	3020	still image
11:54:38	-4.79738	-12.37658	3043	67	4.4	-4.797667	-12.3761673	3020	still image from Sugarhead
11:54:45	-4.79738	-12.37658	3043	67	4.3	-4.797667	-12.3761673	3020	still image
11:54:54	-4.79748	-12.37653	3043	82	4.3	-4.797667	-12.3761673	3020	Sugarhead shows some venting on top
11:55:03	-4.79737	-12.37655	3043	80	4.1	-4.797667	-12.3761673	3018	still image
11:55:39	-4.79738	-12.37658	3044	96	3.9	-4.797667	-12.3761673	3022	shrimps on structure
11:56:30	-4.79738	-12.37657	3045	333	1.6	-4.797667	-12.3763332	3017	turn ROV towards the north
11:56:45	-4.79738	-12.37657	3043	322	3.7	-4.797667	-12.3761673	3020	yes, Shrimp Farm directly in sight
11:57:13	-4.79733	-12.37655	3042	356	5.2	-4.797667	-12.3761673	3022	HD OFF
11:58:44	-4.79730	-12.37653	3044	286	4.1	-4.797667	-12.3761673	3020	moving close to Shrimp Farm
12:01:17	-4.79728	-12.37665	3044	277	4	-4.797667	-12.3761673	3022	HD ON
12:01:26	-4.79753	-12.37668	3044	276	3.9	-4.797667	-12.3761673	3028	HD on Shrimp Farm
12:02:03	-4.79728	-12.37658	3045	265	3.5	-4.797667	-12.3761673	3022	HD OFF
12:03:16	-4.79732	-12.37655	3044	187	4.9	-4.797667	-12.3761673	3026	this is clearly Shrimp Farm, but it is still inactive
12:03:32	-4.79730	-12.37660	3044	172	4.7	-4.797667	-12.3761673	3018	HD ON
12:04:07	-4.79732	-12.37660	3044	157	4.9	-4.797667	-12.3761673	3023	ok, two very small orifices emitting black smoke
12:04:15	-4.79728	-12.37663	3045	157	4	-4.797667	-12.3761673	3023	no shrimps
12:04:50	-4.79730	-12.37663	3045	150	3.6	-4.797667	-12.3761673	3019	still image
12:05:19	-4.79732	-12.37663	3045	148	3.6	-4.797667	-12.3761673	3021	small chimney on larger structure
12:05:29	-4.79732	-12.37663	3045	154	3.6	-4.797667	-12.3761673	3021	HD OFF
12:08:33	-4.79727	-12.37658	3046	313	2.4	-4.797667	-12.3761673	3019	marker 4
12:13:06	-4.79730	-12.37663	3046	90	0.4	-4.797667	-12.3761673	3022	moving E towards Tannenbaum
12:14:50	-4.79733	-12.37657	3039	92	8.9	-4.797667	-12.3761673	3021	HD ON
12:15:15	-4.79737	-12.37667	3041	83	7.1	-4.797667	-12.3761673	3020	HD, believe that this is Tannenbaum, moved to the E from Shripm Farm
12:15:47	-4.79732	-12.37658	3041	103	6.9	-4.797667	-12.3761673	3023	smoke coming out from top, Tannenbaum is more active than in previous years
12:17:38	-4.79732	-12.37655	3041	110	7.3	-4.797667	-12.3761673	3023	still image
12:17:42	-4.79732	-12.37655	3040	110	7.7	-4.797667	-12.3761673	3021	still image
12:17:54	-4.79732	-12.37653	3041	108	6.7	-4.797667	-12.3761673	3021	still images from Tannenbaum
12:18:10	-4.79745	-12.37662	3041	101	7.6	-4.797667	-12.3761673	3020	still image
12:18:27	-4.79730	-12.37655	3042	94	6.3	-4.797667	-12.3761673	3024	still image
12:19:24	-4.79737	-12.37660	3041	30	5.4	-4.797667	-12.3761673	3019	still image
12:19:34	-4.79735	-12.37653	3040	26	6.1	-4.797667	-12.3761673	3021	turn ROV, looking N now
12:19:46	-4.79735	-12.37653	3041	26	5.5	-4.797667	-12.3761673	3021	plenty of smoke coming out from top
12:20:24	-4.79738	-12.37653	3041	28	4.9	-4.797667	-12.3761673	3019	still image
12:22:01	-4.79728	-12.37650	3043	54	4.4	-4.797667	-12.3761673	3021	too fragile to sample or measurea temperature
12:22:33	-4.79737	-12.37655	3042	49	5.4	-4.797667	-12.3761673	3021	turning ROV to south
12:23:49	-4.79738	-12.37662	3046	315	3.1	-4.797667	-12.3761673	3023	turning the other way, W over N
12:23:56	-4.79738	-12.37662	3046	267	2.6	-4.797667	-12.3761673	3020	Shrimp Fram with marker 4
12:24:06	-4.79733	-12.37673	3047	181	1.6	-4.797667	-12.3761673	3020	turning S now
12:24:18	-4.79740	-12.37663	3047	187	1.2	-4.797667	-12.3761673	3020	flying S over pillow lave
12:24:44	-4.79743	-12.37660	3046	105	3	-4.797667	-12.3761673	3021	fish
12:24:54	-4.79745	-12.37662	3046	67	2.5	-4.797667	-12.3761673	3023	turning E
12:25:07	-4.79743	-12.37660	3046	48	2.2	-4.797667	-12.3761673	3023	Sugarhead in sight
12:25:19	-4.79750	-12.37653	3045	46	2.6	-4.797667	-12.3761673	3023	another chimney in the back, must be Mephisto
12:26:00	-4.79742	-12.37655	3043	41	3.8	-4.797667	-12.3761673	3023	Mephisto with white crusts in middle and on top part
12:26:15	-4.79743	-12.37657	3044	63	3.5	-4.797667	-12.3761673	3020	searching for a sampling spot
12:27:02	-4.79738	-12.37655	3043	85	3.8	-4.797667	-12.3761673	3016	HD ON
12:27:12	-4.79737	-12.37655	3042	91	4.5	-4.797667	-12.3761673	3017	Hd still on
12:27:37	-4.79735	-12.37640	3043	--	--	-4.797667	-12.3761673	3017	still image
12:27:53	-4.79740	-12.37652	3042	140	5.4	-4.797667	-12.3761673	3017	still images (2) from Mephisto
12:28:44	-4.79755	-12.37635	3043	208	2.6	-4.797667	-12.3761673	3024	small shrimp on the side of chimney
12:29:26	-4.79737	-12.37653	3043	289	3.4	-4.797667	-12.3761673	3021	looking W, chimney in back (Sugarhead)
12:30:22	-4.79740	-12.37652	3043	297	3.6	-4.797667	-12.3761673	3021	HD OFF
12:30:37	-4.79743	-12.37655	3043	297	3.5	-4.797667	-12.3761673	3020	still image
12:34:33	-4.79737	-12.37652	3042	336	4.6	-4.797667	-12.3761673	3020	HD ON
12:34:51	-4.79740	-12.37650	3042	336	4.3	-4.797667	-12.3761673	3019	HD upper part of Mephisto
12:35:23	-4.79742	-12.37658	3041	336	5.2	-4.797667	-12.3761673	3015	HD OFF
12:35:47	-4.79740	-12.37653	3041	336	5.6	-4.797667	-12.3761673	3028	very fragile structure, broke off a piece when trying to move closer
12:36:19	-4.79737	-12.37657	3041	333	5.3	-4.797667	-12.3761673	3022	HD ON
12:36:59	-4.79732	-12.37652	3042	327	4.6	-4.797667	-12.3761673	3022	HD OFF
12:45:46	-4.79737	-12.37657	3042	333	4.7	-4.797667	-12.3761673	3025	sulfide broke off chimney, lying on porch
12:47:20	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3020	**sample_297 ROV-1**
12:47:32	-4.79738	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3018	sample is sulfide piece (297 ROV 1)
12:47:45	-4.79743	-12.37653	3042	332	4.8	-4.797667	-12.3761673	3019	now starting to sample with KIPS
12:49:20	-4.79737	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3017	first moved sulfide piece to left, out of the way for the starboard porch
12:50:55	-4.79738	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3017	grabing KIPS nozzle
12:53:13	-4.79740	-12.37653	3042	332	4.7	-4.797667	-12.3761673	3020	HD ON
12:55:18	-4.79733	-12.37657	3042	333	4.7	-4.797667	-12.3761673	3020	HD OFF
13:05:29	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3020	highest tempreature is 358°C
13:05:41	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3020	locating a samplin spot
13:06:02	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3021	stable at 353°C, start sampling with KIPS
13:06:43	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3020	pumps on, flushing KIPS system
13:07:07	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3021	pump on and off a few times
13:07:22	-4.79738	-12.37653	3042	--	--	-4.797667	-12.3761673	3021	temperature still at 352°C
13:09:33	-4.79738	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3024	pump on, flushing A1, fluid to be seen at small outlet

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:11:29	-4.79758	-12.37670	3042	332	4.8	-4.797667	-12.3761673	3021	KIPS ON
13:11:29	-4.79758	-12.37670	3042	332	4.8	-4.797667	-12.3761673	3021	**sample_297 ROV-2**
13:11:41	-4.79753	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3019	ZnAc-solution on
13:12:00	-4.79738	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3018	temperature at 341
13:12:25	-4.79752	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3020	KIPS OFF
13:12:34	-4.79737	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3019	ZnAc-pump is off
13:12:44	-4.79737	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3021	fixing solution for 1 minute
13:12:53	-4.79738	-12.37658	3042	333	4.7	-4.797667	-12.3761673	3018	KIPS ON
13:12:58	-4.79738	-12.37658	3042	333	4.7	-4.797667	-12.3761673	3021	pump on
13:13:46	-4.79737	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3018	seeing white smoke, ZnS - solution !
13:14:47	-4.79735	-12.37652	3042	332	4.8	-4.797667	-12.3761673	3020	A1 has been flushed out, needs to be refilled (that is an assumption)
13:15:51	-4.79735	-12.37672	3042	333	4.8	-4.797667	-12.3761673	3021	KIPS off
13:16:03	-4.79735	-12.37672	3042	333	4.8	-4.797667	-12.3761673	3018	ZnAc-solution on
13:17:04	-4.79740	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3021	this is bottle A1 (in situ fix)
13:17:15	-4.79740	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3023	ZnAc pump off
13:18:06	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3763332	3019	that was first fluid sample and second sample of the day 297 ROV-2
13:18:06	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3763332	3019	**297 ROV-3**
13:18:06	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3763332	3019	297 ROV 3 (Bottle A2) Probllem of the multivalveposition
13:18:06	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3763332	3019	**297 ROV-4**
13:18:06	-4.79738	-12.37650	3042	333	4.8	-4.797667	-12.3763332	3019	297 ROV4 (Bottle A3) Problem of the multivalve position
13:18:31	-4.79737	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3021	HD ON
13:19:53	-4.79737	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3022	pump on, filling B4
13:20:17	-4.79737	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3020	**297 ROV-5**
13:20:19	-4.79737	-12.37657	3042	333	4.9	-4.797667	-12.3761673	3020	HD OFF
13:20:47	-4.79740	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3019	temperature 344°C
13:24:52	-4.79740	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3021	pump off, bottle B4 filled, sample297 ROV-5 completed (T between 320 and 350°)
13:25:19	-4.79742	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3021	pump on again for another 2 minutes
13:26:50	-4.79735	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3023	pump off
13:28:08	-4.79740	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3019	pump on, bottle B5
13:29:16	-4.79745	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3019	vigorously pumping - flush position?
13:30:02	-4.79740	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3022	temperature fluctuating between 320 and 350°C
13:30:36	-4.79742	-12.37658	3042	333	4.8	-4.797667	-12.3761673	3024	pump on, still bottle B5, now normal pumping action
13:32:02	-4.79737	-12.37648	3042	333	4.8	-4.797667	-12.3761673	3020	again intense flushing can be seen at exhaust pipe
13:32:11	-4.79735	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3020	keep pumping and filling
13:35:11	-4.79733	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3021	pump off, bottle B5 filled, sample 297ROV-6
13:35:13	-4.79733	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3021	**297 ROV-6**
13:35:40	-4.79735	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3022	first time samplebutton pushed (forgotten up to now)
13:37:05	-4.79738	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3020	pump on, bottle B6
13:38:03	-4.79740	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3017	intense flushing out of exhaust
13:38:47	-4.79743	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3021	temperature at 330°C
13:43:07	-4.79742	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3018	pump off, bottle B6 filled, sample 297 ROV-7 completed
13:43:09	-4.79742	-12.37653	3042	333	4.9	-4.797667	-12.3761673	3019	**297 ROV-7**
13:45:07	-4.79738	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3018	pump on and off
13:45:19	-4.79738	-12.37653	3042	333	4.7	-4.797667	-12.3761673	3017	finishing KIPS sampling
13:46:46	-4.79738	-12.37653	3042	332	4.8	-4.797667	-12.3761673	3025	HD ON
13:47:46	-4.79738	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3022	three cone shaped inactive chimneys in front on top of Mephisto
13:47:58	-4.79737	-12.37653	3042	333	4.8	-4.797667	-12.3761673	3022	knocking off the left two with Rigmaster
13:48:10	-4.79742	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3022	trying to collect this piece
13:49:11	-4.79737	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3021	sampling of chimney piece not possible
13:49:33	-4.79735	-12.37648	3042	333	4.8	-4.797667	-12.3761673	3016	HD OFF
13:52:58	-4.79740	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3019	stow away KIPS
13:55:35	-4.79733	-12.37650	3042	333	4.7	-4.797667	-12.3761673	3020	KIPS stowed away, next task is Ti-major
14:03:55	-4.79742	-12.37652	3042	333	4.8	-4.797667	-12.3761673	3018	grabing Ti-major A1
14:04:58	-4.79738	-12.37658	3042	333	4.7	-4.797667	-12.3761673	3020	HD ON
14:05:22	-4.79740	-12.37650	3042	332	4.7	-4.797667	-12.3761673	3020	HD from Ti-major
14:20:07	-4.79740	-12.37652	3042	333	4.8	-4.797667	-12.3763332	3020	Ti Major does not release
14:20:27	-4.79740	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3020	Ti Majot No: A1
14:30:23	-4.79737	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3021	Major A1 into drawer
14:33:39	-4.79733	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3021	start of attempt to put sulfide from porch into sample box
14:34:20	-4.79742	-12.37652	3042	333	4.8	-4.797667	-12.3763332	3020	opening box
14:37:49	-4.79748	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3021	box open
14:39:16	-4.79740	-12.37652	3042	333	4.7	-4.797667	-12.3761673	3020	preparing to grab the sample from the porch
14:39:20	-4.79742	-12.37648	3042	333	4.8	-4.797667	-12.3761673	3020	HD ON
14:42:24	-4.79737	-12.37650	3042	333	4.8	-4.797667	-12.3761673	3022	HD OFF
14:46:30	-4.79735	-12.37657	3042	333	4.8	-4.797667	-12.3761673	3022	sampleis in the box, trying to rotate the sample in order to fit it in
14:49:24	-4.79738	-12.37628	3042	333	4.8	-4.797667	-12.3761673	3021	box closed with sample inside
14:52:30	-4.79747	-12.37663	3042	333	4.8	-4.797667	-12.3761673	3019	test to see if Rigmaster can approach the orifice for He sampling
14:53:56	-4.79735	-12.37645	3042	333	4.8	-4.797667	-12.3761673	3019	orifice is within reach, preparing to grab He sampler
15:01:00	-4.79733	-12.37655	3042	333	4.8	-4.797667	-12.3761673	3022	HD ON
15:01:19	-4.79730	-12.37660	3042	333	4.8	-4.797667	-12.3761673	3020	taking He-sampler No.5
15:02:47	-4.79742	-12.37652	3042	332	4.8	-4.797667	-12.3761673	3021	HD OFF
15:03:20	-4.79740	-12.37650	3042	332	4.8	-4.797667	-12.3761673	3021	He-sampler in Orion arm

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
15:09:41	-4.79728	-12.37653	3042	328	4.8	-4.797667	-12.3761673	3021	He-sampler above the orifice, trying to grab it with Rigmaster
15:12:18	-4.79740	-12.37652	3042	289	5.1	-4.797667	-12.3761673	3019	ship is dragging us,5m more cable
15:16:32	-4.79735	-12.37650	3042	329	5	-4.797667	-12.3761673	3019	ROV moved slightly, starboard side in the smoke
15:25:11	-4.79737	-12.37652	3042	329	5	-4.797667	-12.3761673	3022	repositioned, starting to grab sampler with Rigmaster
15:25:19	-4.79738	-12.37653	3042	329	5	-4.797667	-12.3761673	3021	upper velve closed
15:30:23	-4.79735	-12.37653	3042	329	5	-4.797667	-12.3761673	3018	**297 ROV-8**
15:31:00	-4.79738	-12.37655	3042	329	5	-4.797667	-12.3761673	3020	still image
15:37:31	-4.79733	-12.37652	3042	329	5	-4.797667	-12.3761673	3018	lower velve closed
15:38:18	-4.79742	-12.37657	3042	329	4.9	-4.797667	-12.3761673	3021	switch He-sampler fromRigmaster to Orion for storing
15:39:50	-4.79737	-12.37652	3042	329	5	-4.797667	-12.3761673	3019	He-sampler in Orion
15:44:20	-4.79740	-12.37663	3042	329	5	-4.797667	-12.3761673	3021	stowing He-sampler in tray
15:52:15	-4.79738	-12.37652	3042	329	4.9	-4.797667	-12.3761673	3020	He-sampler stowed away; one switch likely opened during stowing
15:55:54	-4.79745	-12.37650	3042	329	5	-4.797667	-12.3761673	3021	HD ON
15:56:25	-4.79743	-12.37652	3042	329	5	-4.797667	-12.3761673	3021	take-off, heading for Tannenbaum for temp. measurement
15:58:13	-4.79765	-12.37643	3043	221	4	-4.797667	-12.3761673	3017	HD OFF
16:10:39	-4.79738	-12.37618	3041	292	5.9	-4.797667	-12.3761673	3021	HD ON
16:11:34	-4.79740	-12.37652	3041	339	4.7	-4.797667	-12.3761673	3021	HD OFF
16:18:22	-4.79732	-12.37648	3041	268	7.2	-4.797667	-12.3761673	3021	at Tannenbaum, looking for good spot
16:18:33	-4.79732	-12.37648	3040	--	--	-4.797667	-12.3761673	3020	pilot change
16:31:07	-4.79740	-12.37635	3041	281	6.1	-4.797667	-12.3760004	3016	at Tannenbaum
16:31:22	-4.79772	-12.37622	3041	282	5.9	-4.797667	-12.3760004	3024	taking KIPS into Orion
16:34:19	-4.79738	-12.37640	3041	282	5.9	-4.797667	-12.3760004	3017	HD ON
16:36:15	-4.79735	-12.37638	3041	283	6.3	-4.797667	-12.3760004	3019	prepare to take temp. reading
16:43:20	-4.79740	-12.37635	3041	295	6.5	-4.797667	-12.3760004	3019	T max 353°C
16:43:44	-4.79717	-12.37647	3042	296	5.2	-4.797667	-12.3760004	3019	HD OFF
16:48:27	-4.79807	-12.37568	3043	296	4.4	-4.797667	-12.3760004	3017	leaving Red Lion
16:49:18	-4.79733	-12.37638	3042	83	5.4	-4.797667	-12.3760004	3019	turning stbd onto new course (120°)
16:50:03	-4.79735	-12.37637	3044	123	3.4	-4.797667	-12.3760004	3020	pillows with Fe-staining
16:50:45	-4.79735	-12.37642	3045	123	2.6	-4.797667	-12.3760004	3018	pillow lava, unsedimented
16:51:01	-4.79742	-12.37632	3045	123	1.7	-4.797667	-12.3760004	3018	pillow lava, unsedimented
16:51:09	-4.79737	-12.37640	3045	123	1.9	-4.797667	-12.3760004	3022	pillow lava, slightly sedimented
16:51:27	-4.79738	-12.37625	3045	123	1.8	-4.797667	-12.3760004	3019	lobate flow, slightly sedimented
16:51:46	-4.79740	-12.37620	3044	123	2.6	-4.797667	-12.3760004	3015	lobate flow, slightly sedimented
16:51:55	-4.79737	-12.37622	3044	124	2.3	-4.797667	-12.3760004	3015	Seastar
16:51:56	-4.79737	-12.37622	3044	124	2.2	-4.797667	-12.3760004	3015	Holothurian
16:52:05	-4.79725	-12.37637	3044	123	2.3	-4.797667	-12.3760004	3021	lobate flow, slightly sedimented
16:52:23	-4.79737	-12.37620	3044	123	2.2	-4.797667	-12.3760004	3019	sediment in round patches
16:52:47	-4.79747	-12.37610	3043	123	2	-4.797667	-12.3758326	3019	lobate flow, slightly sedimented
16:53:16	-4.79738	-12.37618	3042	125	2.1	-4.797667	-12.3758326	3018	lobate flow, slightly sedimented
16:53:43	-4.79750	-12.37600	3042	131	1.9	-4.797667	-12.3758326	3027	lobate flow, slightly sedimented
16:54:22	-4.79750	-12.37595	3040	132	4.3	-4.797667	-12.3758326	3022	lobate flow, slightly sedimented
16:54:54	-4.79752	-12.37597	3041	132	2.9	-4.797667	-12.3758326	3018	few skylights
16:55:51	-4.79752	-12.37592	3041	132	2.9	-4.797667	-12.3758326	3015	waiting for the ship
16:58:17	-4.79758	-12.37592	3041	132	2.9	-4.797833	-12.3756666	3018	lobate flow, slightly sedimented
16:59:16	-4.79763	-12.37558	3040	132	2.8	-4.797833	-12.3756666	3015	lobate flow, slightly sedimented
16:59:33	-4.79760	-12.37572	3041	133	2	-4.797833	-12.3756666	3015	jumbled lava
16:59:52	-4.79758	-12.37567	3039	--	--	-4.797833	-12.3756666	3015	tectonized area
17:02:03	-4.79763	-12.37548	3041	133	1.8	-4.797833	-12.3754997	3014	drainback features
17:02:06	-4.79767	-12.37565	3041	132	1.6	-4.7979999	-12.3754997	3014	still image
17:02:14	-4.79767	-12.37565	3041	132	1.7	-4.7979999	-12.3754997	3013	still image
17:02:57	-4.79780	-12.37557	3040	131	2.2	-4.7979999	-12.3754997	3014	collapse pit
17:03:43	-4.79772	-12.37550	3040	131	3	-4.7979999	-12.3753328	3015	jumbled lava
17:04:13	-4.79753	-12.37545	3040	132	2	-4.7979999	-12.3753328	3016	lobate flow, slightly sedimented
17:04:27	-4.79787	-12.37565	3039	132	2.9	-4.7979999	-12.3753328	3015	jumbled lava
17:05:34	-4.79792	-12.37542	3039	131	2.2	-4.7979999	-12.3753328	3013	broken lobate flows wirh minor sediment
17:05:46	-4.79780	-12.37545	3038	130	2.8	-4.7979999	-12.3753328	3016	few pillows appearing
17:06:16	-4.79790	-12.37532	3037	131	1.9	-4.7979999	-12.3753328	3010	still image
17:07:09	-4.79787	-12.37518	3034	126	2.2	-4.7979999	-12.3751669	3011	tectonized lava
17:07:18	-4.79788	-12.37533	3034	126	2.3	-4.7979999	-12.3751669	3012	still image
17:07:41	-4.79783	-12.37533	3035	126	1.6	-4.7981672	-12.3751669	3011	still image
17:07:46	-4.79797	-12.37523	3034	127	1.9	-4.7981672	-12.3751669	3013	highly tectonized,
17:08:45	-4.79802	-12.37552	3032	126	3	-4.7981672	-12.3751669	3010	jumbled lava
17:08:46	-4.79802	-12.37552	3032	126	3.1	-4.7981672	-12.3751669	3010	jumbled lava
17:09:02	-4.79802	-12.37552	3032	126	3.7	-4.7981672	-12.3751669	3012	jumbled lava
17:09:12	-4.79793	-12.37515	3031	126	3.5	-4.7981672	-12.3751669	3014	jumbled lava
17:09:25	-4.79792	-12.37515	3032	126	2.3	-4.7981672	-12.3751669	3015	jumbled lava
17:09:52	-4.79795	-12.37508	3030	126	3.4	-4.7981672	-12.3751669	3016	HD OFF
17:10:11	-4.79797	-12.37505	3030	126	2.8	-4.7981672	-12.3751669	3011	jumbled lava
17:10:53	-4.79793	-12.37503	3029	157	4	-4.7981672	-12.375	3013	contact between hackly lava and lobate + pillows to the left
17:10:59	-4.79805	-12.37500	3029	157	3.3	-4.7981672	-12.375	3022	jumbled lava
17:11:15	-4.79805	-12.37500	3030	157	2.8	-4.7981672	-12.375	3009	jumbled lava
17:11:46	-4.79808	-12.37500	3028	169	4.5	-4.7981672	-12.375	3011	jumbled lava
17:12:25	-4.79817	-12.37497	3030	222	3.2	-4.7981672	-12.375	3009	cone is visible in the sonar, slightly to SW
17:12:36	-4.79817	-12.37503	3030	221	1.6	-4.7981672	-12.375	3007	moving over hackly lava to cone
17:13:33	-4.79813	-12.37500	3028	222	4.8	-4.7983332	-12.375	3011	jumbled lava
17:14:20	-4.79815	-12.37500	3031	221	2.7	-4.7983332	-12.3748331	3009	pillows flow over the hackly lava
17:14:23	-4.79817	-12.37497	3032	222	2	-4.7983332	-12.375	3010	jumbled lava
17:15:08	-4.79817	-12.37518	3031	222	3.2	-4.7983332	-12.3748331	3009	HD ON
17:15:31	-4.79825	-12.37497	3032	222	1.7	-4.7983332	-12.3748331	3011	still image
17:16:12	-4.79825	-12.37502	3028	222	5.3	-4.7983332	-12.3748331	3011	pillow mound ahead, younger than flows at the floor

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:16:27	-4.79852	-12.37483	3026	211	6.7	-4.7983332	-12.3748331	3008	movin towards top of the pillow mound
17:16:42	-4.79832	-12.37502	3025	211	5.9	-4.7983332	-12.3748331	3008	talus, boulder size
17:17:08	-4.79833	-12.37502	3023	211	6.9	-4.7983332	-12.3748331	3028	HD OFF
17:18:12	-4.79827	-12.37512	3023	210	4.1	-4.7983332	-12.3746672	3013	at the top of the mound,
17:18:14	-4.79827	-12.37512	3023	211	4.1	-4.7983332	-12.3748331	3025	still image
17:19:45	-4.79838	-12.37495	3021	134	4.7	-4.7985001	-12.3746672	3008	moving 110° towards next target,possibly another pillow mound
17:20:49	-4.79833	-12.37492	3024	108	5.7	-4.7985001	-12.3746672	3007	target is 180m in 100
17:23:10	-4.79833	-12.37485	3030	107	3.3	-4.7985001	-12.3745003	3007	jumbled lava
17:23:35	-4.79832	-12.37485	3032	108	2.9	-4.7985001	-12.3745003	3005	few sheets with abundant jumbled areas and round sediment pods
17:24:15	-4.79837	-12.37470	3032	113	2	-4.7985001	-12.3745003	3008	jumbled lava
17:24:23	-4.79837	-12.37470	3030	112	3.4	-4.7985001	-12.3745003	3008	collapse pit
17:25:15	-4.79828	-12.37472	3030	112	1.9	-4.7985001	-12.3745003	3007	still image
17:25:27	-4.79835	-12.37462	3029	113	3.2	-4.7985001	-12.3745003	3008	still image
17:25:37	-4.79837	-12.37475	3029	--	--	-4.7985001	-12.3745003	3008	lobate flow, slightly sedimented
17:26:25	-4.79830	-12.37448	3028	112	3.1	-4.7985001	-12.3743334	3005	lobate flow, slightly sedimented
17:27:01	-4.79835	-12.37442	3025	121	6.1	-4.7985001	-12.3743334	3005	lobate flow, slightly sedimented
17:27:18	-4.79772	-12.37468	3027	120	3.8	-4.7985001	-12.3743334	3009	jumbled lava
17:27:29	-4.79833	-12.37438	3028	121	2.4	-4.7985001	-12.3743334	3010	collapse pit
17:28:17	-4.79817	-12.37443	3029	119	1.7	-4.7985001	-12.3743334	3011	still image
17:29:15	-4.79807	-12.37452	3028	111	2.6	-4.7985001	-12.3741674	3004	still image
17:29:49	-4.79828	-12.37437	3026	122	4.8	-4.7985001	-12.3741674	3010	lobate to sheets with anbundant skylights grading in tectonized terrain
17:30:03	-4.79837	-12.37420	3026	123	4.4	-4.7985001	-12.3741674	3006	hackly java
17:31:02	-4.79838	-12.37418	3024	122	3.8	-4.798667	-12.3741674	3006	hackly lava
17:31:24	-4.79838	-12.37418	3023	--	--	-4.798667	-12.3741674	3006	hackly lava with pillow remnants
17:32:04	-4.79838	-12.37418	3023	--	--	-4.798667	-12.3741674	3006	lobate flow, slightly sedimented
17:32:06	-4.79838	-12.37418	3023	--	--	-4.798667	-12.3741674	3006	jumbled lava
17:33:28	-4.79843	-12.37388	3021	108	4	-4.798667	-12.3739996	3005	lobates within hackly lava
17:34:44	-4.79847	-12.37370	3019	121	4	-4.798667	-12.3739996	3006	lobates within hackly lava
17:35:13	-4.79847	-12.37370	3021	120	2.6	-4.798667	-12.3739996	3006	lobate flow, slightly sedimented
17:36:04	-4.79852	-12.37363	3019	115	5.3	-4.798667	-12.3738327	3008	hackly lava
17:36:34	-4.79853	-12.37362	3021	111	2.6	-4.798667	-12.3738327	3004	still image
17:37:20	-4.79853	-12.37343	3021	108	2.6	-4.798667	-12.3738327	3005	HD ON
17:39:21	-4.79850	-12.37352	3017	107	4.4	-4.798667	-12.3736668	3005	hackly lava
17:39:23	-4.79850	-12.37352	3017	103	4.9	-4.798667	-12.3736668	3005	HD OFF
17:39:24	-4.79850	-12.37352	3017	100	5.2	-4.798667	-12.3736668	3005	HD OFF
17:40:52	-4.79855	-12.37335	3016	157	3.8	-4.798667	-12.3736668	3003	lobates within hackly lava
17:41:59	-4.79867	-12.37327	3018	157	2.6	-4.798667	-12.3734999	3009	hackly lava
17:42:09	-4.79867	-12.37327	3017	156	3.1	-4.798667	-12.3734999	3004	jumbled lava
17:42:58	-4.79877	-12.37327	3019	161	2.3	-4.798667	-12.3734999	3003	still image
17:43:01	-4.79877	-12.37327	3018	160	2.5	-4.798667	-12.3734999	3003	nice flow banding in lobate flows
17:45:01	-4.79882	-12.37315	3019	176	0.9	-4.7988329	-12.373333	3003	HD ON
17:45:05	-4.79882	-12.37315	3019	--	--	-4.7988329	-12.373333	3016	turning 160! towards Sisters Peak
17:46:02	-4.79883	-12.37325	3019	184	1	-4.7988329	-12.373333	3003	Rattail
17:46:24	-4.79888	-12.37317	3019	184	1.2	-4.7988329	-12.373333	3000	still image
17:46:38	-4.79878	-12.37333	3019	179	0.8	-4.7988329	-12.373333	3002	still image
17:47:00	-4.79895	-12.37312	3019	181	0.6	-4.7988329	-12.373333	3001	HD OFF
17:48:11	-4.79898	-12.37310	3018	166	1.3	-4.7988329	-12.373333	3001	still image
17:48:27	-4.79892	-12.37310	3018	165	1.3	-4.7988329	-12.373167	3003	collapse pits in sheets to lobate flows
17:49:26	-4.79898	-12.37308	3018	164	1.1	-4.7988329	-12.373167	3000	waiting for ship to catch up
17:50:06	-4.79900	-12.37308	3018	164	1.2	-4.7988329	-12.373167	2998	lobate flow, slightly sedimented
17:50:26	-4.79927	-12.37302	3017	163	0.9	-4.7988329	-12.373167	3010	pillow lava, slightly sedimented
17:51:01	-4.79900	-12.37298	3015	164	2.8	-4.7988329	-12.373167	2995	still image
17:51:39	-4.79893	-12.37300	3015	163	2.6	-4.7988329	-12.3730001	2998	HD ON
17:52:19	-4.79962	-12.37337	3014	163	1.3	-4.7988329	-12.3730001	2997	pillow lava, unsedimented
17:52:57	-4.79913	-12.37292	3012	162	1.2	-4.7988329	-12.3730001	2997	HD OFF
17:53:03	-4.79913	-12.37292	3012	162	1	-4.7988329	-12.3730001	2997	lobate flow, slightly sedimented
17:53:50	-4.79923	-12.37285	3012	156	1.1	-4.7989998	-12.3730001	3005	lobate flow, slightly sedimented
17:54:18	-4.79925	-12.37285	3012	156	1.5	-4.7989998	-12.3730001	2991	still image
17:55:03	-4.79928	-12.37282	3011	156	1.6	-4.7989998	-12.3728333	2991	lobate flow, slightly sedimented
17:55:29	-4.79930	-12.37282	3011	155	1.1	-4.7991672	-12.3728333	2993	skylights in lobate
17:56:10	-4.79935	-12.37278	3010	160	1.5	-4.7991672	-12.3728333	2992	collapse pit
17:56:57	-4.79938	-12.37275	3011	181	1.3	-4.7993331	-12.3728333	2989	sheet flow, slightly sedimented
17:57:39	-4.79952	-12.37267	3010	163	0.9	-4.7993331	-12.3728333	2997	contacttonice sheet flow
17:57:43	-4.79952	-12.37267	3010	163	1.2	-4.7993331	-12.3728333	2992	still image
17:58:57	-4.79965	-12.37263	3010	162	1	-4.7995	-12.3726673	2991	collapsed sheet flows
17:59:18	-4.79967	-12.37260	3009	162	1.7	-4.7995	-12.3726673	2989	mussel patch
17:59:57	-4.79968	-12.37260	3010	163	1.1	-4.7995	-12.3726673	2988	marker as M15
17:59:59	-4.79968	-12.37262	3010	163	1	-4.7995	-12.3726673	2988	HD ON
18:00:11	-4.79970	-12.37258	3010	163	0.8	-4.7996669	-12.3726673	2986	still image
18:00:41	-4.79972	-12.37258	3009	160	1	-4.7996669	-12.3726673	3021	younger flows associated with mussel beds
18:00:45	-4.79972	-12.37258	3009	160	1	-4.7996669	-12.3726673	2988	still image
18:00:52	-4.79978	-12.37258	3009	156	0.9	-4.7996669	-12.3726673	2992	more musselbeds
18:01:26	-4.79978	-12.37255	3008	157	1.5	-4.7996669	-12.3726673	2984	mussel bed
18:01:48	-4.79985	-12.37252	3009	157	1	-4.7998328	-12.3726673	2990	HD OFF
18:02:08	-4.79988	-12.37247	3007	156	2.1	-4.7998328	-12.3726673	2987	back in tectonized sheet flows
18:02:23	-4.79990	-12.37248	3006	171	3	-4.7998328	-12.3726673	2985	fish
18:02:54	-4.79993	-12.37250	3006	158	2.8	-4.7998328	-12.3725004	2984	fish
18:03:01	-4.80000	-12.37248	3006	150	2.7	-4.7998328	-12.3725004	2987	fish
18:03:24	-4.80002	-12.37243	3005	164	3.1	-4.7998328	-12.3725004	2991	hackly lava
18:04:10	-4.80010	-12.37240	3003	165	3.1	-4.8000002	-12.3725004	2989	pressure ridges in tectonized lava
18:04:29	-4.80015	-12.37238	3005	166	1.8	-4.8000002	-12.3725004	2980	hackly lava
18:05:01	-4.80025	-12.37238	3003	165	2.8	-4.8000002	-12.3725004	2986	contact between hackly lava and shhet flows to the east
18:05:43	-4.80035	-12.37235	3005	166	2	-4.8001671	-12.3725004	2985	sheet flow with sediment ponds
18:06:26	-4.80045	-12.37223	3006	165	0.9	-4.8001671	-12.3725004	2986	still image

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
18:07:21	-4.80052	-12.37225	3002	--	--	-4.800333	-12.3723326	2986	still image
18:07:35	-4.80057	-12.37232	3002	168	2.8	-4.800333	-12.3723326	2983	islands of sheet flows in a sea of hackly lava
18:07:53	-4.80058	-12.37227	3002	168	2.3	-4.800333	-12.3723326	2986	a single lobate
18:09:24	-4.80075	-12.37218	3001	176	1.9	-4.8004999	-12.3723326	2986	empty mussels
18:09:25	-4.80075	-12.37218	3001	175	2.1	-4.8004999	-12.3723326	2986	still image
18:10:11	-4.80083	-12.37218	2999	176	2.2	-4.8004999	-12.3723326	2984	more scattered empty shellswithin hackly lava
18:11:46	-4.80105	-12.37212	2999	175	1.8	-4.8006668	-12.3721666	2981	hackly lava and collapse structure, some filter feeders
18:12:03	-4.80103	-12.37208	2998	173	2.2	-4.8008332	-12.3721666	2981	fish
18:12:42	-4.80122	-12.37213	2998	173	2	-4.8008332	-12.3721666	2981	track is alongside small (1 m wide) fissure
18:13:05	-4.80123	-12.37207	2997	168	3	-4.8008332	-12.3721666	2984	tectonized area within sheet flows
18:14:58	-4.80138	-12.37200	2997	167	2.2	-4.8010001	-12.3719997	2979	hackly lava in sedimented sheet flow
18:15:46	-4.80143	-12.37197	2997	170	3	-4.801167	-12.3719997	2980	collapsed structures abundant
18:15:53	-4.80122	-12.37260	2997	170	2.9	-4.801167	-12.3719997	2980	waiting for the ship
18:17:32	-4.80152	-12.37190	2998	172	1.4	-4.801333	-12.3719997	2977	still image
18:17:47	-4.80157	-12.37193	2998	171	1.2	-4.801333	-12.3719997	2976	still image
18:17:51	-4.80157	-12.37193	2998	171	1	-4.801333	-12.3719997	2976	still image
18:18:27	-4.80162	-12.37188	2997	171	1.6	-4.801333	-12.3718328	2977	pillows ahead
18:18:55	-4.80165	-12.37188	2996	170	2.6	-4.8014998	-12.3718328	2978	pillow lava, slightly sedimented
18:19:34	-4.80172	-12.37187	2997	185	0.4	-4.8014998	-12.3718328	2973	still image
18:19:43	-4.80173	-12.37185	2995	--	--	-4.8014998	-12.3718328	2978	still image
18:20:07	-4.80177	-12.37185	2996	185	1.5	-4.8014998	-12.3718328	2978	120m to Foggy Corner
18:20:12	-4.80177	-12.37185	2995	185	1.5	-4.8014998	-12.3718328	2977	pillow lava, slightly sedimented
18:21:06	-4.80188	-12.37180	2994	180	2.1	-4.8016672	-12.3718328	2976	pillow lava, unsedimented
18:22:10	-4.80198	-12.37182	2991	180	3	-4.8018332	-12.3718328	2976	pillow lava, unsedimented
18:23:09	-4.80208	-12.37183	2991	189	1.9	-4.8018332	-12.3716669	2974	fog in the water column
18:23:13	-4.80208	-12.37183	2991	191	1.4	-4.8018332	-12.3716669	2974	pillow lava, unsedimented
18:23:37	-4.80218	-12.37182	2990	175	1.4	-4.8018332	-12.3716669	2975	lobate flow, unsedimented
18:23:55	-4.80220	-12.37182	2989	175	1.6	-4.802	-12.3716669	2978	Crab
18:24:01	-4.80220	-12.37182	2989	175	1.8	-4.802	-12.3716669	2969	pillow lava, unsedimented
18:24:09	-4.80222	-12.37182	2989	175	2.1	-4.802	-12.3716669	2974	Crab
18:24:24	-4.80227	-12.37178	2989	175	1.9	-4.802	-12.3716669	2978	pillow lava, unsedimented
18:24:39	-4.80227	-12.37175	2990	176	1.5	-4.802	-12.3716669	2973	more crabs and filter feeders
18:25:03	-4.80228	-12.37173	2990	175	2.5	-4.802	-12.3716669	2978	pillow lava, unsedimented
18:25:37	-4.80238	-12.37172	2991	176	2.8	-4.8021669	-12.3715	2973	pillow lava, unsedimented
18:26:25	-4.80247	-12.37172	2993	176	3.9	-4.8021669	-12.3715	2976	many sessile organ on basalt pillows
18:27:41	-4.80255	-12.37170	2996	193	1.3	-4.8023329	-12.3715	2977	lobate flow, slightly sedimented
18:28:06	-4.80268	-12.37165	2997	187	1.2	-4.8023329	-12.3715	2974	hackly lava contact with sheets
18:28:31	-4.80270	-12.37167	2996	188	1.9	-4.8023329	-12.3715	2970	sheet flow, slightly sedimented
18:28:48	-4.80270	-12.37163	2998	189	0.8	-4.8024998	-12.3715	2973	still image
18:29:24	-4.80278	-12.37163	2996	187	2.7	-4.8024998	-12.3715	2975	pressure ridge in sheet flows
18:30:25	-4.80290	-12.37163	2999	194	0.8	-4.8026671	-12.3713331	2974	fractured shett flow
18:30:29	-4.80290	-12.37163	2999	194	0.7	-4.8026671	-12.3713331	2974	still image
18:31:00	-4.80280	-12.37165	2996	192	3.9	-4.8026671	-12.3713331	2974	sheet flow, slightly sedimented
18:31:13	-4.80295	-12.37173	2995	192	4.8	-4.8026671	-12.3713331	2974	mussel patch
18:31:22	-4.80300	-12.37163	2995	189	5.3	-4.8026671	-12.3713331	2975	fish
18:33:52	-4.80388	-12.37080	2996	140	3.7	-4.803	-12.3711672	2975	mussel patch
18:35:08	-4.80330	-12.37142	2998	167	2.3	-4.803	-12.3713331	2972	mussel patches in tectonized lava
18:35:15	-4.80330	-12.37142	2997	166	2.7	-4.803	-12.3713331	2972	Crab
18:36:32	-4.80288	-12.37183	2996	106	2.6	-4.803	-12.3711672	2967	turning east towards fissure visible in sonar
18:36:48	-4.80340	-12.37137	2996	99	3.5	-4.803	-12.3711672	2971	mussel patch
18:37:23	-4.80333	-12.37137	2993	108	2.9	-4.803	-12.3711672	2975	Crab
18:39:11	-4.80368	-12.37117	2995	174	2	-4.8031669	-12.3710003	2976	fissure
18:40:00	-4.80347	-12.37118	2995	178	2.7	-4.8031669	-12.3710003	2974	north/south tranding fissure
18:40:02	-4.80347	-12.37118	2995	178	2.6	-4.8031669	-12.3710003	2974	still image
18:40:18	-4.80348	-12.37118	2996	178	2.1	-4.8031669	-12.3710003	2973	still image
18:40:26	-4.80348	-12.37115	2996	178	2	-4.8031669	-12.3710003	2976	still image
18:42:43	-4.80380	-12.37102	2996	154	1.2	-4.8033328	-12.3710003	2974	still image
18:42:46	-4.80380	-12.37102	2996	155	1.1	-4.8035002	-12.3710003	2974	still image
18:43:19	-4.80367	-12.37108	2996	157	0.9	-4.8035002	-12.3710003	2970	HD ON
18:43:24	-4.80367	-12.37108	2996	157	0.9	-4.8035002	-12.3710003	2970	HD ON
18:43:31	-4.80365	-12.37105	2996	--	--	-4.8035002	-12.3710003	2970	still image
18:44:02	-4.80363	-12.37105	2997	142	0.8	-4.8035002	-12.3710003	2971	still image
18:44:04	-4.80363	-12.37105	2997	140	0.8	-4.8035002	-12.3710003	2971	still image
18:44:07	-4.80363	-12.37105	2996	137	1.1	-4.8035002	-12.3710003	2972	bionet ahead
18:44:12	-4.80363	-12.37105	2996	138	1.3	-4.8035002	-12.3710003	2972	mussel bed
18:48:14	-4.80372	-12.37102	2996	291	0.6	-4.8035002	-12.3708334	2973	electronic marker 16
18:48:17	-4.80372	-12.37102	2996	291	0.6	-4.8035002	-12.3708334	2973	mussel bed
18:53:02	-4.80388	-12.37087	2996	18	1.6	-4.8039999	-12.3704996	2971	moving northward along fissure, it seems that this was **Clueless** and it is situated SE (!) of Sisters Peak!!
18:55:21	-4.80387	-12.37102	2994	--	--	-4.8039999	-12.3704996	2969	still image
18:55:26	-4.80387	-12.37102	2994	14	0.8	-4.8039999	-12.3704996	2973	still image
18:55:54	-4.80380	-12.37093	2993	14	1.4	-4.8039999	-12.3704996	2965	still image
18:56:30	-4.80377	-12.37087	2993	28	1.4	-4.8039999	-12.3704996	2967	fissure is here very deep and trending 10-20°
18:57:02	-4.80365	-12.37098	2992	27	2.2	-4.8039999	-12.3704996	2970	lava pillar
18:57:32	-4.80387	-12.37077	2993	5	0.7	-4.8039999	-12.3704996	2970	drainage features
18:57:37	-4.80375	-12.37093	2993	3	0.7	-4.8039999	-12.3704996	2974	still image
18:58:01	-4.80368	-12.37087	2992	11	0.5	-4.8039999	-12.3704996	2965	still image
18:58:05	-4.80368	-12.37087	2992	10	0.4	-4.8039999	-12.3704996	2965	fissure
18:59:14	-4.80368	-12.37092	2993	6	1.3	-4.8039999	-12.3704996	2973	still image
19:01:27	-4.80355	-12.37090	2993	357	2.9	-4.8039999	-12.3704996	2970	HD OFF
19:01:35	-4.80355	-12.37093	2993	1	2.7	-4.8039999	-12.3704996	2974	fault
19:01:47	-4.80355	-12.37093	2994	1	0.9	-4.8039999	-12.3704996	2966	Crab
19:02:09	-4.80320	-12.36738	2994	357	2.1	-4.8039999	-12.3704996	2975	fissure
19:02:16	-4.80320	-12.36738	2994	--	--	-4.8039999	-12.3704996	2972	still image
19:03:24	-4.80352	-12.37095	2992	12	2.5	-4.8039999	-12.3704996	2971	fish
19:03:57	-4.80292	-12.37108	2992	7	2.1	-4.8039999	-12.3704996	2969	HD ON

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
19:05:06	-4.80342	-12.37097	2992	29	0.7	-4.8039999	-12.3704996	2970	arrived at **Golden Valley**
19:05:08	-4.80342	-12.37097	2992	29	0.7	-4.8039999	-12.3704996	2970	still image
19:05:11	-4.80342	-12.37097	2992	30	0.6	-4.8039999	-12.3704996	2970	mussel bed
19:06:22	-4.80337	-12.37102	2990	35	3.3	-4.803833	-12.3706675	2971	still image
19:06:37	-4.80333	-12.37103	2989	39	2.7	-4.803833	-12.3706675	2964	still image
19:07:41	-4.80332	-12.37102	2987	65	4.4	-4.803833	-12.3706675	2971	still image
19:08:23	-4.80325	-12.37113	2984	351	5.8	-4.8036671	-12.3708334	2972	heading to Sisters Peak
19:08:33	-4.80332	-12.37107	2984	317	5.8	-4.8036671	-12.3708334	2979	pillow basalt at the top
19:09:50	-4.80330	-12.37123	2991	236	2	-4.8036671	-12.3710003	2974	HD OFF
19:16:35	-4.80337	-12.37140	2996	236	1.2	-4.8036671	-12.3710003	2973	piles of jumbled lava followed by sheet flows
19:17:03	-4.80342	-12.37140	2997	235	2.1	-4.8036671	-12.3710003	2973	still image
19:17:22	-4.80340	-12.37143	2998	236	2	-4.8035002	-12.3710003	2977	still image from this
19:18:08	-4.80345	-12.37140	2998	236	1.5	-4.8036671	-12.3710003	2977	sheet flow, slightly sedimented
19:19:37	-4.80347	-12.37148	2999	236	1.6	-4.8036671	-12.3710003	2972	moved 70m by now
19:19:52	-4.80343	-12.37157	2999	236	1.7	-4.8036671	-12.3710003	2977	heading still 256
19:20:47	-4.80348	-12.37145	2999	225	1.4	-4.8035002	-12.3710003	2970	structure in sonar, turning vehicle, heading 225
19:22:02	-4.80343	-12.37148	2998	184	2.1	-4.8036671	-12.3710003	2975	still image
19:22:38	-4.80343	-12.37153	2998	201	2.1	-4.8036671	-12.3710003	2972	shadow in sonar was a large pile of jumbled lava
19:23:25	-4.80353	-12.37150	2997	236	3.2	-4.8036671	-12.3710003	2974	lobate lava flow on top of jumbled lava
19:24:43	-4.80350	-12.37152	2996	236	2.7	-4.8036671	-12.3710003	2975	still image
19:25:03	-4.80352	-12.37150	2996	236	2.7	-4.8036671	-12.3710003	2977	sheet flow/lobate lava
19:25:15	-4.80352	-12.37150	2996	237	2.6	-4.8036671	-12.3710003	2975	sheet flow, slightly sedimented
19:25:30	-4.80363	-12.37157	2996	237	2.6	-4.8036671	-12.3710003	2974	collapse pit
19:25:45	-4.80375	-12.37150	2997	238	2.5	-4.8036671	-12.3710003	2984	collapse pit
19:26:32	-4.80367	-12.37157	2995	327	3.8	-4.8035002	-12.3710003	2968	turning vehicle clockwise
19:26:41	-4.80362	-12.37157	2996	327	3.5	-4.8036671	-12.3710003	2979	more collapse pits
19:27:05	-4.80397	-12.37100	2995	307	3.5	-4.8036671	-12.3710003	2978	turning counter clockwise
19:27:05	-4.80397	-12.37100	2995	307	3.5	-4.8036671	-12.3710003	2978	
19:27:56	-4.80363	-12.37148	2996	241	3	-4.8036671	-12.3710003	2973	turning from N via W to S
19:30:29	-4.80360	-12.37155	2996	141	3.1	-4.8036671	-12.3710003	2981	difficult to locate Sisters Peak on sonar
19:32:36	-4.80362	-12.37152	2996	259	3.2	-4.8036671	-12.3710003	2970	now heading W
19:34:34	-4.80377	-12.37163	2996	259	3.1	-4.8036671	-12.3710003	2971	lobate flow, slightly sedimented
19:35:09	-4.80363	-12.37165	2996	258	2.9	-4.8035002	-12.3710003	2986	collapse pits of different size
19:37:08	-4.80365	-12.37177	2996	205	2.6	-4.8036671	-12.3710003	2972	turning vehicle around for view
19:37:56	-4.80363	-12.37173	2995	323	4.1	-4.8036671	-12.3710003	2974	no chimney structure in sight
19:38:52	-4.80353	-12.37168	2996	18	3.4	-4.8036671	-12.3710003	2974	moving north to northeast (heading 24°)
19:39:33	-4.80350	-12.37182	2995	18	3.7	-4.8036671	-12.3710003	2978	still image
19:42:27	-4.80338	-12.37165	2997	318	2.6	-4.8036671	-12.3710003	2975	heading 327 now towards shadow on sonar
19:42:52	-4.80333	-12.37187	2996	318	3.5	-4.8036671	-12.3710003	2971	again a collapse structure, not a chimney
19:43:02	-4.80343	-12.37172	2997	318	2.8	-4.8036671	-12.3710003	2975	still image
19:46:57	-4.80335	-12.37167	2995	99	4.8	-4.8036671	-12.3710003	2976	mussels in collapse pit
19:48:00	-4.80337	-12.37168	2998	104	2.6	-4.8036671	-12.3710003	2970	only mussel shells
19:48:52	-4.80325	-12.37155	2999	31	2.5	-4.8036671	-12.3710003	2978	still image
19:49:32	-4.80328	-12.37163	2998	5	2.1	-4.8036671	-12.3710003	2974	heading straight N
19:53:38	-4.80320	-12.37162	2992	202	6.5	-4.8036671	-12.3710003	2975	turning around for view
19:53:57	-4.80328	-12.37168	2993	202	5.3	-4.8036671	-12.3710003	2973	6.1m above ground, nothing in sonar
19:54:12	-4.80305	-12.37175	2994	202	4.2	-4.8036671	-12.3710003	2975	finish observations
19:54:20	-4.80305	-12.37175	2995	202	4	-4.8035002	-12.3710003	2975	OFF THE BOTTOM
21:20:59	0.00000	0.00000	44	--	--	-4.8035002	-12.3710003	2978	ON DECK

Cruise: MAR SOUTH V
Date: 22.04.2009
Station: M78-2_302ROV
Targets: Sisters Peak, Golden Valley, Clueless

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:12:16	0.00000	0.00000	0	--	--	-4.803833	-12.3725	8	IN THE WATER
13:53:11	-4.80295	-12.37402	1580	85	37.6	-4.8041668	-12.3704996	8	testing KIPS and flushing
14:02:48	-4.80265	-12.37317	1999	85	37.6	-4.8041668	-12.3703327	0	ROV at 2000m, descending without problems; some noise in HD image
14:04:33	-4.80298	-12.37290	2076	85	37.6	-4.8041668	-12.3703327	0	flushing and testing of the KIPS system finished
14:06:29	-4.80295	-12.37280	2161	110	37.6	-4.8041668	-12.3703327	0	still image
14:14:16	-4.80317	-12.37242	2510	114	37.6	-4.8041668	-12.3704996	0	ROV at 2500m, no problems
14:22:39	-4.80318	-12.37205	2907	101	37.6	-4.8041668	-12.3703327	0	ROV at 2900m,no problem, descending
14:23:46	-4.80295	-12.37213	2961	101	33.6	-4.8041668	-12.3703327	0	altimeter kicks in
14:24:51	-4.80298	-12.37312	2991	161	5.0	-4.8041668	-12.3704996	0	AT THE BOTTOM
14:25:24	-4.80318	-12.37198	2992	158	4.3	-4.8041668	-12.3704996	0	at bottom lobate flows, structure in sonar image
14:27:10	-4.80345	-12.37190	2992	93	3.7	-4.8039999	-12.3704996	0	scattered mussels
14:28:07	-4.80303	-12.37202	2994	98	2.2	-4.8039999	-12.3704996	0	sulfide talus ahead
14:31:21	-4.80333	-12.37187	2993	58	3.6	-4.8039999	-12.3704996	0	at Sisters Peak, exactly where it should be on the map!
14:37:59	-4.80330	-12.37187	2996	41	0.3	-4.8041668	-12.3703327	0	Searching place to place Die Fasts during work at Sisters Peak
14:38:58	-4.80330	-12.37178	2996	42	0.3	-4.8041668	-12.3704996	0	placing 1. Die Fast
14:40:05	-4.80348	-12.37185	2996	42	0.3	-4.8041668	-12.3704996	0	Die Fast 1 placed
14:42:28	-4.80335	-12.37183	2996	40	0.3	-4.8041668	-12.3704996	8	Rattail
14:43:22	-4.80350	-12.37188	2996	40	0.3	-4.8041668	-12.3704996	8	Rattail
14:43:22	-4.80350	-12.37188	2996	40	0.3	-4.8041668	-12.3704996	8	fish
14:43:23	-4.80350	-12.37188	2996	40	0.3	-4.8041668	-12.3704996	8	fish
14:43:24	-4.80350	-12.37188	2996	40	0.3	-4.8041668	-12.3704996	0	fish
14:44:38	-4.80340	-12.37182	2996	40	0.3	-4.8041668	-12.3704996	0	fish
14:44:39	-4.80340	-12.37182	2996	40	0.3	-4.8041668	-12.3704996	0	fish
14:44:44	-4.80340	-12.37182	2996	40	0.3	-4.8041668	-12.3704996	0	Die Fast 2 placed
14:46:17	-4.80338	-12.37183	2996	40	0.3	-4.8041668	-12.3704996	0	picking up Ti-Major
14:54:27	-4.80343	-12.37178	2996	39	0.3	-4.8039999	-12.3703327	0	Ti-Major dropped down
14:57:07	-4.80333	-12.37185	2996	39	0.3	-4.8041668	-12.3703327	0	picking up Ti-Major D1 by Orion
15:00:40	-4.80318	-12.37168	2996	40	0.3	-4.8041668	-12.3703327	0	Major D1 picked
15:02:28	-4.80337	-12.37185	2992	39	4.4	-4.8043332	-12.3701668	0	searching sampling site
15:03:14	-4.80317	-12.37183	2983	38	12.4	-4.8043332	-12.3701668	0	HD ON
15:03:35	-4.80323	-12.37182	2980	37	14.7	-4.8043332	-12.3701668	0	still image
15:04:17	-4.80348	-12.37187	2981	1	13.1	-4.8043332	-12.3701668	0	still image
15:04:42	-4.80322	-12.37183	2981	322	12.3	-4.8041668	-12.3703327	0	Top of Sister Peak
15:05:38	-4.80330	-12.37172	2980	303	13.3	-4.8041668	-12.3703327	0	still image
15:05:49	-4.80330	-12.37172	2980	298	13.4	-4.8041668	-12.3703327	0	still image
15:05:58	-4.80327	-12.37180	2980	275	14.0	-4.8041668	-12.3703327	0	still image
15:06:28	-4.80328	-12.37177	2980	231	14.5	-4.8041668	-12.3703327	0	still image
15:07:16	-4.80327	-12.37183	2980	--	--	-4.8041668	-12.3703327	0	still image
15:08:54	-4.80325	-12.37182	2981	197	12.4	-4.8041668	-12.3703327	0	taking position
15:09:07	-4.80323	-12.37183	2981	195	12.5	-4.8041668	-12.3703327	0	HD OFF
15:10:41	-4.80322	-12.37175	2981	203	12.7	-4.8039999	-12.3704996	0	start of sampling
15:15:42	-4.80320	-12.37185	2981	203	12.5	-4.8039999	-12.3706675	0	sample_1
15:16:47	-4.80323	-12.37182	2981	203	12.5	-4.8039999	-12.3706675	0	Ti-Major D1 filled Sister Peak hot Fluid
15:21:00	-4.80323	-12.37180	2981	202	12.5	-4.8039999	-12.3704996	8	storing Major in the drawer
15:25:08	-4.80322	-12.37182	2981	203	12.6	-4.8039999	-12.3704996	0	preparing KIPS temperature measurment from vent where fluid was taken
15:26:37	-4.80328	-12.37178	2981	211	14.1	-4.8039999	-12.3704996	0	still image
15:29:12	-4.80327	-12.37180	2981	331	12.6	-4.8039999	-12.3704996	0	moving back to store Major
15:31:37	-4.80333	-12.37188	2981	310	13.0	-4.8039999	-12.3704996	0	storing Major
15:36:37	-4.80322	-12.37180	2981	243	13.3	-4.8039999	-12.3706675	0	Major stored
15:36:49	-4.80323	-12.37177	2981	242	13.2	-4.8039999	-12.3706675	0	opening sample box
15:41:01	-4.80322	-12.37182	2980	223	13.7	-4.8039999	-12.3706675	0	searching position for taking sulfide sample from top
15:41:45	-4.80318	-12.37180	2981	214	13.1	-4.8039999	-12.3704996	0	HD ON
15:46:46	-4.80325	-12.37180	2980	320	14.2	-4.8039999	-12.3704996	0	HD OFF
15:46:51	-4.80320	-12.37180	2980	319	13.1	-4.8039999	-12.3704996	0	HD OFF
15:49:41	-4.80318	-12.37180	2980	260	13.5	-4.8039999	-12.3704996	0	taking shouvel to sample sulfide
15:55:17	-4.80322	-12.37183	2980	256	13.6	-4.8039999	-12.3704996	0	sample_2
15:55:45	-4.80318	-12.37177	2981	277	13.8	-4.8039999	-12.3704996	0	sulfide age 0
16:00:47	-4.80328	-12.37182	2983	52	13.0	-4.8039999	-12.3706675	0	preparing to sample shrimp with slurp gun
16:02:49	-4.80323	-12.37188	2981	42	13.7	-4.8039999	-12.3706675	0	HD ON
16:05:27	-4.80327	-12.37185	2983	28	10.5	-4.8041668	-12.3706675	0	start sampling
16:07:06	-4.80327	-12.37175	2983	28	10.5	-4.8041668	-12.3706675	0	to sample box 1 of rotary
16:07:08	-4.80327	-12.37175	2983	28	10.4	-4.8041668	-12.3706675	0	sample_3
16:17:25	-4.80325	-12.37183	2983	27	12.0	-4.8039999	-12.3706675	0	turning rotary to position 2
16:20:01	-4.80322	-12.37185	2983	27	10.5	-4.8039999	-12.3706675	0	sample_4
16:22:12	-4.80342	-12.37188	2983	27	12.0	-4.8039999	-12.3706675	0	roary 2
16:25:42	-4.80322	-12.37178	2983	20	11.1	-4.8041668	-12.3704996	0	stop of sampling
16:25:51	-4.80317	-12.37188	2983	11	10.8	-4.8041668	-12.3704996	0	HD OFF
16:26:10	-4.80327	-12.37185	2982	7	12.2	-4.8041668	-12.3704996	0	rotating sampler
16:32:24	-4.80337	-12.37197	2996	71	0.3	-4.8041668	-12.3706675	0	shift change for ROV
16:40:41	-4.80338	-12.37192	2992	147	4.1	-4.8039999	-12.3706675	0	pilots changed
16:41:11	-4.80330	-12.37178	2992	143	4.4	-4.8039999	-12.3706675	0	will turn to heading 300° from base of Sisters Peak and go to the diffuse fluid site
16:46:49	-4.80328	-12.37168	2994	26	3.1	-4.8041668	-12.3706675	2967	now at base of sister peak starting to move 300° towards diffuse fluids site
16:57:14	-4.80332	-12.37192	2995	95	1.8	-4.8041668	-12.3704996	2973	trying to find diffuse site at sisters peak

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:07:41	-4.80328	-12.37197	2994	342	2.7	-4.8041668	-12.3704996	2970	from sisters peak 342° few seconds flying and found diffuse site
17:09:59	-4.80325	-12.37212	2993	18	3.3	-4.8041668	-12.3704996	2971	inactive chimney
17:13:27	-4.80342	-12.37213	2992	71	4.8	-4.8041668	-12.3704996	2970	are at the diffuse site waiting for ??
17:14:23	-4.80328	-12.37230	2990	116	6.5	-4.8041668	-12.3704996	2973	inactive chimney is directly next to diffuse site
17:18:06	-4.80322	-12.37207	2996	207	0.4	-4.8039999	-12.3706675	2973	HD ON
17:19:23	-4.80275	-12.37267	2996	207	0.4	-4.8039999	-12.3706675	2969	HD OFF
17:20:44	-4.80323	-12.37203	2996	216	0.5	-4.8039999	-12.3706675	2968	shrimps (large and small), actinia;
17:20:54	-4.80330	-12.37205	2996	216	0.5	-4.8039999	-12.3706675	2968	crabs
17:23:39	-4.80303	-12.37218	2996	215	0.5	-4.8041668	-12.3704996	2975	HD ON
17:26:01	0.00083	-0.00147	2996	215	0.5	-4.8039999	-12.3704996	2968	HD OFF
17:26:35	-4.80312	-12.37195	2996	216	0.5	-4.8041668	-12.3704996	2967	problem with grabbing kips handle because of slurp gun being in the way
17:28:54	-4.80322	-12.37205	2996	215	0.5	-4.8041668	-12.3704996	2962	Rimicaris, scattered
17:28:56	-4.80320	-12.37205	2996	215	0.5	-4.8041668	-12.3704996	2962	Rimicaris, scattered
17:29:06	-4.80317	-12.37198	2996	215	0.5	-4.8041668	-12.3704996	2962	shimmering water
17:29:07	-4.80317	-12.37198	2996	215	0.5	-4.8041668	-12.3704996	2962	diffuse outflow
17:39:44	-4.80325	-12.37197	2996	215	0.5	-4.8041668	-12.3703327	2964	KIPS ON
17:39:45	-4.80325	-12.37197	2996	215	0.5	-4.8041668	-12.3703327	2964	sample_5
17:41:17	-4.80322	-12.37212	2996	215	0.5	-4.8041668	-12.3703327	2970	still image
17:41:39	-4.80327	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2964	t=11°C (KIPS C8) 302 ROV 5
17:41:42	-4.80327	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2972	still image
17:41:54	-4.80323	-12.37202	2996	215	0.5	-4.8041668	-12.3703327	2972	HD ON
17:42:42	-4.80352	-12.37210	2996	215	0.5	-4.8041668	-12.3703327	2965	HD OFF
17:42:51	-4.80323	-12.37202	2996	215	0.5	-4.8041668	-12.3703327	2971	still image
17:43:01	-4.80322	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2970	still image
17:43:31	-4.80325	-12.37207	2996	215	0.5	-4.8041668	-12.3703327	2968	still image
17:44:48	-4.80313	-12.37202	2996	215	0.5	-4.8041668	-12.3703327	2971	KIPS OFF
17:45:26	-4.80323	-12.37205	2996	215	0.5	-4.8041668	-12.3703327	2969	KIPS ON
17:45:28	-4.80327	-12.37215	2996	215	0.5	-4.8041668	-12.3703327	2980	sample_6
17:46:05	-4.80322	-12.37207	2996	215	0.5	-4.8041668	-12.3703327	2974	KIPS C7 (302 ROV 6)
17:50:06	-4.80323	-12.37202	2996	215	0.5	-4.8041668	-12.3703327	2974	HD ON
17:50:35	-4.80317	-12.37213	2996	215	0.5	-4.8041668	-12.3703327	2968	HD OFF
17:50:40	-4.80325	-12.37212	2996	215	0.5	-4.8041668	-12.3703327	2968	KIPS OFF
17:51:11	-4.80322	-12.37200	2996	215	0.5	-4.8041668	-12.3703327	2962	KIPS ON
17:51:13	-4.80340	-12.37205	2996	215	0.5	-4.8041668	-12.3703327	2962	sample_7
17:51:43	-4.80322	-12.37202	2996	215	0.5	-4.8041668	-12.3703327	2969	KIPS C9 (302 ROV 7)
17:52:41	-4.80322	-12.37203	2996	215	0.5	-4.8043332	-12.3703327	2964	still image
17:52:42	-4.80322	-12.37203	2996	215	0.5	-4.8043332	-12.3703327	2964	still image
17:53:11	-4.80325	-12.37220	2996	215	0.5	-4.8041668	-12.3703327	2969	KIPS OFF
17:53:40	-4.80330	-12.37173	2996	215	0.5	-4.8041668	-12.3703327	2971	KIPS ON
17:55:11	-4.80325	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2969	t 7.7-10°C
17:55:25	-4.80323	-12.37198	2996	215	0.5	-4.8041668	-12.3703327	2970	12°C
17:56:06	-4.80315	-12.37208	2996	215	0.5	-4.8041668	-12.3703327	2972	13.5°C
17:56:45	-4.80322	-12.37205	2996	215	0.5	-4.8041668	-12.3703327	2969	KIPS OFF
17:57:19	-4.80320	-12.37208	2996	215	0.5	-4.8041668	-12.3703327	2973	KIPS ON
17:57:19	-4.80320	-12.37208	2996	215	0.5	-4.8041668	-12.3703327	2973	sample_8
17:58:19	-4.80328	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2970	KIPS B6 (302 ROV 8)
17:58:25	-4.80333	-12.37197	2996	215	0.5	-4.8041668	-12.3703327	2970	14.2°C
17:59:26	-4.80322	-12.37203	2996	216	0.5	-4.8041668	-12.3703327	2963	7.5°C
18:00:28	-4.80322	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2966	KIPS OFF
18:03:32	-4.80327	-12.37203	2996	214	0.5	-4.8041668	-12.3703327	2975	KIPS ON
18:03:44	-4.80348	-12.37245	2996	215	0.5	-4.8041668	-12.3703327	2965	15°C
18:03:48	-4.80348	-12.37245	2996	215	0.5	-4.8041668	-12.3703327	2967	16°C
18:07:57	-4.80323	-12.37198	2996	215	0.5	-4.8041668	-12.3703327	2968	shrimp, scattered
18:07:59	-4.80323	-12.37198	2996	215	0.5	-4.8041668	-12.3703327	2968	Crab
18:08:16	-4.80322	-12.37198	2996	215	0.5	-4.8041668	-12.3703327	2966	KIPS OFF
18:08:16	-4.80322	-12.37198	2996	215	0.5	-4.8041668	-12.3703327	2966	KIPS OFF
18:09:48	-4.80320	-12.37203	2996	215	0.5	-4.8041668	-12.3703327	2957	HD ON
18:09:59	-4.80315	-12.37208	2996	216	0.5	-4.8041668	-12.3703327	2968	HD OFF
18:14:40	-4.80193	-12.37117	2994	293	2.2	-4.8041668	-12.3703327	2969	HD ON
18:14:52	-4.80370	-12.37185	2994	295	2.5	-4.8041668	-12.3703327	2968	HD OFF
18:16:30	-4.80330	-12.37183	2994	177	2.6	-4.8041668	-12.3703327	2963	back at Sisters Peak, seeing the diefasts
18:21:24	-4.80335	-12.37183	2996	183	0.4	-4.8041668	-12.3701668	2968	landing next to diefasts
18:26:56	-4.80332	-12.37188	2996	184	0.4	-4.8039999	-12.3703327	2969	collecting diefast
18:37:17	-4.80340	-12.37187	2996	184	0.3	-4.8041668	-12.3703327	2972	taking die fast onto porch
18:39:43	-4.80332	-12.37182	2996	186	0.4	-4.8041668	-12.3703327	2963	die fast on porch
18:47:17	-4.80333	-12.37187	2996	169	0.2	-4.8041668	-12.3701668	2965	major secured in tray
18:48:01	-4.80330	-12.37187	2996	171	0.2	-4.8041668	-12.3701668	2965	grabbing die fast 2 and stowing on front porch
18:50:37	-4.80335	-12.37187	2996	170	0.2	-4.8041668	-12.3703327	2972	everything stowed, preparing to leave for Clueless
18:53:31	-4.80328	-12.37183	2996	168	0.3	-4.8041668	-12.3703327	2969	lift off
18:54:41	-4.80320	-12.37147	2994	130	2.7	-4.8041668	-12.3703327	2974	flying 105° over hackly lava
18:54:51	-4.80348	-12.37212	2994	113	2.7	-4.8041668	-12.3703327	2974	lobate flow, slightly sedimented
18:55:41	-4.80352	-12.37188	2994	106	2.3	-4.8041668	-12.3703327	2974	sheet flow, slightly sedimented
18:56:25	-4.80342	-12.37173	2995	106	2.1	-4.8041668	-12.3703327	2969	contact with hackly lava
18:57:35	-4.80350	-12.37157	2993	106	2.1	-4.8041668	-12.3703327	2973	sheet flow, slightly sedimented
18:58:39	-4.80352	-12.37138	2993	106	2.2	-4.8041668	-12.3703327	2965	Actinaria
18:59:03	-4.80352	-12.37137	2992	106	2.2	-4.8041668	-12.3701668	2973	hydrothermsl sediment in pods
18:59:21	-4.80348	-12.37133	2992	106	1.9	-4.8041668	-12.3701668	2968	still image
18:59:32	-4.80348	-12.37130	2991	107	2.3	-4.8041668	-12.3701668	2967	still image
18:59:34	-4.80348	-12.37130	2991	106	2.6	-4.8041668	-12.3701668	2967	still image
18:59:39	-4.80352	-12.37132	2992	107	1.7	-4.8041668	-12.3701668	2967	Octopus
18:59:55	-4.80357	-12.37135	2991	106	2.2	-4.8041668	-12.3701668	2968	sheet flow, slightly sedimented
18:59:58	-4.80357	-12.37135	2991	106	2.4	-4.8041668	-12.3701668	2968	Holothurian
19:01:26	-4.80360	-12.37112	2987	106	2.5	-4.8041668	-12.3701668	2965	tectonized sheets, fissure in sonar ahead
19:02:50	-4.80360	-12.37113	2987	197	2.4	-4.8041668	-12.3701668	2967	at fissure turning south, fissure is too narrow

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
19:09:00	-4.80365	-12.37098	2984	39	4.4	-4.8041668	-12.3701668	2967	move to a small fissure, followed a few meters south but seems too small, 15 m further east next fissure, heading back north
19:10:01	-4.80370	-12.37083	2986	36	3.0	-4.8041668	-12.3701668	2966	fish
19:11:11	-4.80360	-12.37087	2986	95	2.6	-4.8041668	-12.3701668	2962	fissure ends here, turning east again, trying to locate next fissure
19:11:46	-4.80353	-12.37088	2985	93	3.0	-4.8041668	-12.3701668	2972	hackly lava
19:12:42	-4.80357	-12.37077	2985	91	3.1	-4.8041668	-12.3703327	2968	lobate flow, slightly sedimented
19:13:17	-4.80345	-12.37080	2985	91	2.2	-4.8041668	-12.3703327	2966	still image
19:15:07	-4.80355	-12.37082	2984	87	3.1	-4.8041668	-12.3703327	2967	went too far east, turning vehicle beack to a NW course
19:15:12	-4.80353	-12.37073	2984	84	3.4	-4.8041668	-12.3703327	2967	pillow lava, slightly sedimented
19:16:01	-4.80352	-12.37073	2984	284	3.4	-4.8041668	-12.3701668	2966	on track directing NW
19:17:18	-4.80353	-12.37088	2984	285	3.6	-4.8041668	-12.3701668	2969	fissure ahead (20m)
19:22:08	-4.80338	-12.37105	2988	11	2.3	-4.8041668	-12.3703327	2965	at that fissure
19:22:16	-4.80337	-12.37120	2988	11	2.5	-4.8041668	-12.3703327	2964	mussels scattered
19:22:35	-4.80347	-12.37113	2989	13	3.2	-4.8041668	-12.3703327	2969	fish
19:30:54	-4.80362	-12.37105	2988	202	2.2	-4.8039999	-12.3703327	2972	driving north along fissure,mussels on the eastern side, scattered
19:31:21	-4.80377	-12.37110	2989	194	1.6	-4.8039999	-12.3703327	2965	lobate flows cut by fissure
19:31:28	-4.80382	-12.37110	2989	193	1.3	-4.8039999	-12.3703327	2971	fissure widening again
19:33:14	-4.80405	-12.37118	2991	192	4.2	-4.8041668	-12.3703327	2966	sheet flows east mussels ahead
19:49:41	-4.80407	-12.37085	2994	238	1.7	-4.8041668	-12.3703327	2966	back online (had lost power)
19:54:50	-4.80398	-12.37097	2995	297	0.2	-4.8041668	-12.3703327	2986	still image
19:55:03	-4.80417	-12.37092	2995	297	0.2	-4.8041668	-12.3703327	2964	still image
20:00:21	-4.80413	-12.37088	2995	297	0.2	-4.8041668	-12.3703327	2977	putting down die fasts on an even ground
20:06:16	-4.80472	-12.37078	2995	297	0.2	-4.8041668	-12.3703327	2964	positioning the second diefast
20:11:12	-4.80417	-12.37082	2995	297	0.2	-4.8041668	-12.3703327	2969	lost the knive and are recollecting it
20:18:55	-4.80442	-12.37090	2994	--	--	-4.8041668	-12.3703327	2961	still image
20:20:18	-4.80425	-12.37098	2996	--	--	-4.8041668	-12.3703327	2966	HD ON
20:20:23	-4.80425	-12.37098	2996	94	0.3	-4.8041668	-12.3703327	2966	still image
20:22:17	-4.80418	-12.37090	2996	91	0.3	-4.8041668	-12.3703327	2983	slurp gun in the way of kips
20:23:44	-4.80418	-12.37098	2995	89	0.3	-4.8041668	-12.3703327	2976	HD OFF
20:26:01	-4.80422	-12.37097	2995	89	0.3	-4.8041668	-12.3703327	2974	grabbing nozzle handle of KIPS
20:32:47	-4.80420	-12.37088	2995	89	0.3	-4.8041668	-12.3703327	2967	still trying to grab handle
20:41:14	-4.80420	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2966	KIPS ON
20:41:15	-4.80420	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2966	sample_9
20:42:35	-4.80438	-12.37090	2995	89	0.3	-4.8041668	-12.3703327	2969	still image
20:42:37	-4.80438	-12.37090	2995	89	0.3	-4.8041668	-12.3703327	2969	HD ON
20:42:43	-4.80418	-12.37092	2995	89	0.3	-4.8041668	-12.3703327	2969	HD OFF
20:45:01	-4.80422	-12.37095	2995	89	0.3	-4.8041668	-12.3701668	2964	KIPS OFF
20:45:19	-4.80432	-12.37092	2995	89	0.3	-4.8041668	-12.3701668	2966	302 ROV 9 in situ fixierung (KIPS A1)
20:45:29	-4.80417	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2966	dosierpumpe an
20:46:29	-4.80410	-12.37112	2995	89	0.3	-4.8041668	-12.3701668	2966	KIPS ON
20:47:22	-4.80422	-12.37090	2995	89	0.3	-4.8039999	-12.3703327	2966	sample_10
20:48:14	-4.80417	-12.37088	2995	89	0.3	-4.8041668	-12.3703327	2967	Rimicaris, swarms
20:48:24	-4.80413	-12.37093	2995	89	0.3	-4.8041668	-12.3703327	2967	mussel patch
20:48:28	-4.80413	-12.37093	2995	89	0.3	-4.8041668	-12.3703327	2970	Crab
20:50:46	-4.80412	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2967	KIPS OFF
20:51:15	-4.80415	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2968	KIPS ON
20:51:15	-4.80415	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2968	sample_11
20:51:46	-4.80417	-12.37095	2995	89	0.3	-4.8041668	-12.3701668	2965	302 ROV 11 (KIPS B4) t 13°C
20:55:01	-4.80395	-12.37088	2995	89	0.3	-4.8041668	-12.3701668	2971	KIPS OFF
20:55:34	-4.80417	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2966	KIPS ON
20:55:35	-4.80417	-12.37098	2995	89	0.3	-4.8041668	-12.3701668	2966	sample_12
20:57:35	-4.80415	-12.37097	2995	89	0.3	-4.8041668	-12.3701668	2964	302 ROV 12 (KIPS B4 12.7°C
20:59:46	-4.80398	-12.37103	2995	89	0.3	-4.8041668	-12.3701668	2963	KIPS OFF
21:00:01	-4.80413	-12.37095	2995	89	0.3	-4.8041668	-12.3701668	2969	KIPS ON
21:01:21	-4.80418	-12.37060	2995	89	0.3	-4.8041668	-12.3701668	2983	302 ROV 13 (KIPS B5)
21:03:45	-4.80420	-12.37100	2995	89	0.3	-4.8041668	-12.3701668	2968	KIPS OFF
21:05:30	-4.80407	-12.37103	2995	86	0.3	-4.8041668	-12.3701668	2973	max t is 13.6°C
21:07:47	-4.80415	-12.37092	2995	86	0.3	-4.8041668	-12.3703327	2966	finish KIPS measurements
21:10:42	-4.80413	-12.37088	2995	86	0.3	-4.8041668	-12.3701668	2961	put out marker 34 next to sampling spot
21:14:55	-4.80403	-12.37090	2995	85	0.3	-4.8041668	-12.3701668	2966	picking up shovel to collect mussels
21:16:43	-4.80430	-12.37070	2995	87	0.3	-4.8041668	-12.3701668	2965	scooping up mussels now
21:17:23	-4.80413	-12.37093	2995	87	0.3	-4.8041668	-12.3701668	2972	plenty of shrimp irritated by mussel sampling
21:17:55	-4.80418	-12.37087	2995	87	0.3	-4.8043332	-12.3701668	2970	mussels in shovel, now flying to DIE FAST
21:18:30	-4.80415	-12.37088	2995	87	0.3	-4.8043332	-12.3701668	2960	samplegoes to DIE FAST 2
21:22:15	-4.80402	-12.37107	2995	318	0.2	-4.8043332	-12.3703327	2978	position the ROV in front of DIE FAST
21:22:30	-4.80403	-12.37102	2995	318	0.2	-4.8043332	-12.3703327	2968	place shovel on grey box in sample drawer
21:24:07	-4.80412	-12.37090	2995	320	0.2	-4.8043332	-12.3703327	2958	open DIE FAST 2
21:26:07	-4.80430	-12.37085	2995	319	0.2	-4.8045001	-12.3703327	2971	lid is open now
21:28:13	-4.80420	-12.37062	2995	320	0.2	-4.8043332	-12.3704996	2963	grab shovel from top of grey box
21:30:03	-4.80415	-12.37108	2995	320	0.2	-4.8043332	-12.3704996	2967	another challenge: place only few mussels (not all in the shovel) into DIE FAST
21:30:47	-4.80412	-12.37092	2995	321	0.2	-4.8043332	-12.3704996	2965	still image
21:31:00	-4.80403	-12.37133	2995	321	0.2	-4.8043332	-12.3704996	2977	still image:placing mussels into DIE FAST
21:33:42	-4.80413	-12.37098	2995	321	0.2	-4.8043332	-12.3704996	2963	mussels in the pot
21:34:09	-4.80422	-12.37092	2995	320	0.2	-4.8043332	-12.3704996	2969	sample_13
21:34:44	-4.80420	-12.37098	2995	320	0.2	-4.8043332	-12.3704996	2973	now place the shovel with remaining musselson top of grey box in sample drawer
21:36:31	-4.80405	-12.37103	2995	321	0.2	-4.8043332	-12.3704996	2960	now close the lit of DIE FAST
21:41:12	-4.80420	-12.37083	2995	320	0.2	-4.8043332	-12.3704996	2971	trigger the magnesium chloride solution
21:41:44	-4.80420	-12.37097	2995	320	0.2	-4.8043332	-12.3704996	2965	DIE FAST !!!
21:41:57	-4.80437	-12.37078	2995	320	0.2	-4.8043332	-12.3704996	2967	open lit of DIE FAST 1 now
21:42:56	-4.80420	-12.37103	2995	320	0.2	-4.8043332	-12.3704996	2970	HD OFF
21:45:01	-4.80415	-12.37097	2995	320	0.2	-4.8043332	-12.3704996	2967	lid of DIE FAST 1 is open
21:45:52	-4.80413	-12.37083	2995	321	0.2	-4.8041668	-12.3704996	2969	grab shovel and place remaining two mussels into DIE FAST 1

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
21:49:00	-4.80413	-12.37055	2995	320	0.2	-4.8041668	-12.3703327	2964	actually,three mussels were still in the shovel, are now in the DIE FAST
21:50:38	-4.80373	-12.37092	2995	322	0.2	-4.8041668	-12.3703327	2963	go back to same sampling spot for a few more mussels
21:51:51	-4.80410	-12.37095	2995	82	0.3	-4.8041668	-12.3704996	2970	open the grey box for more mussels
21:52:09	-4.80423	-12.37102	2995	82	0.3	-4.8041668	-12.3704996	2967	try opening the lid with the shovel
21:53:34	-4.80420	-12.37087	2995	81	0.3	-4.8041668	-12.3704996	2971	no, placing shovel on the porch
21:56:13	-4.80428	-12.37090	2995	--	--	-4.8039999	-12.3703327	2975	still image
21:56:37	-4.80778	-12.37837	2995	81	0.3	-4.8039999	-12.3703327	2961	still image
21:56:48	-4.80778	-12.37837	2995	81	0.3	-4.8039999	-12.3703327	2970	2 still images with shovel
21:57:12	-4.80413	-12.37088	2995	81	0.3	-4.8039999	-12.3703327	2972	still image
21:57:25	-4.80422	-12.37093	2995	81	0.3	-4.8039999	-12.3703327	2972	another still image with mussels in the shovel
21:58:05	-4.80430	-12.37093	2995	81	0.3	-4.8039999	-12.3703327	2965	place full scoop of mussels in grey box
21:58:09	-4.80425	-12.37083	2995	81	0.3	-4.8039999	-12.3703327	2965	sample_14
21:58:34	-4.80417	-12.37092	2995	82	0.3	-4.8039999	-12.3703327	2969	this is the full scoop of mussels just collected and placed in grey sample box
21:59:24	-4.80413	-12.37083	2995	81	0.3	-4.8039999	-12.3703327	2966	collect three more for the DIE FAST 1
22:00:45	-4.80405	-12.37102	2995	81	0.3	-4.8041668	-12.3703327	2970	HD film of "pancake type" mussel catching
22:00:50	-4.80420	-12.37100	2995	81	0.3	-4.8041668	-12.3703327	2973	HD OFF
22:01:03	-4.80415	-12.37097	2995	82	0.7	-4.8041668	-12.3703327	2970	moving ROV to DIE FAST 1
22:01:53	-4.80413	-12.37095	2994	305	1.1	-4.8041668	-12.3703327	2972	still image
22:01:57	-4.80413	-12.37095	2994	305	1.2	-4.8041668	-12.3703327	2966	still image
22:02:06	-4.80413	-12.37095	2994	306	1.3	-4.8041668	-12.3703327	2965	still image
22:02:22	-4.79718	-12.37428	2994	282	1.2	-4.8041668	-12.3703327	2963	few overview shots with still image camera
22:04:24	-4.80417	-12.37093	2995	299	0.2	-4.8041668	-12.3703327	2972	place mussels into pot of DIE FAST 1
22:06:32	-4.80420	-12.37093	2995	299	0.2	-4.8041668	-12.3704996	2967	mussels are in the pot
22:08:31	-4.80398	-12.37100	2995	299	0.2	-4.8039999	-12.3704996	2972	place shovel in sample drawer
22:10:49	-4.80408	-12.37105	2995	297	0.2	-4.8041668	-12.3704996	2969	still image
22:12:44	-4.80417	-12.37098	2995	297	0.2	-4.8041668	-12.3704996	2972	close lid of DIE FAST 1, sample collected
22:12:46	-4.80417	-12.37098	2995	297	0.2	-4.8041668	-12.3704996	2972	sample_15
22:14:33	-4.80420	-12.37090	2995	259	0.3	-4.8041668	-12.3704996	2968	repositioning the ROV for better access and vision
22:15:17	-4.80413	-12.37097	2995	257	0.3	-4.8041668	-12.3704996	2969	hold DIE FAST 1 with Rigmaster on left side
22:16:29	-4.80423	-12.37075	2995	258	0.3	-4.8041668	-12.3704996	2967	pull trigger successfully
22:24:57	-4.80420	-12.37088	2995	257	0.3	-4.8041668	-12.3703327	2965	next task: looking for rock with young mussels
22:28:31	-4.80400	-12.37098	2993	9	2.4	-4.8041668	-12.3703327	2971	mussel net on the ground - droped on previous cruise
22:30:37	-4.80427	-12.37083	2996	2	0.2	-4.8041668	-12.3703327	2965	HD ON
22:32:05	-4.80417	-12.37100	2996	2	0.2	-4.8041668	-12.3703327	2965	HD OFF
22:33:22	-4.80405	-12.37098	2995	343	0.9	-4.8041668	-12.3703327	2966	collecting the lost net
22:33:33	-4.80403	-12.37102	2995	293	1.1	-4.8041668	-12.3703327	2966	HD ON
22:38:24	-4.80403	-12.37103	2996	224	0.4	-4.8039999	-12.3703327	2964	HD OFF
22:41:29	-4.80413	-12.37100	2996	220	0.4	-4.8039999	-12.3701668	2966	place old lost net into sample drawer
22:43:15	-4.80407	-12.37095	2996	220	0.4	-4.8039999	-12.3701668	2971	move shovel into back of the sample drawer
22:43:54	-4.80403	-12.37093	2996	221	0.4	-4.8039999	-12.3701668	2965	close sample drawer
22:48:54	-4.80443	-12.37018	2996	225	0.8	-4.8039999	-12.3704996	2968	go back to DIE FASTs
22:49:05	-4.80407	-12.37102	2995	229	1.0	-4.8039999	-12.3704996	2967	HD ON
22:53:23	-4.80415	-12.37102	2995	26	1.0	-4.8039999	-12.3704996	2972	positioning ROV next to marker 4 and to diffuse fluid outlet
22:53:43	-4.80418	-12.37092	2995	26	1.0	-4.8039999	-12.3704996	2970	marker 34
22:54:42	-4.80413	-12.37098	2995	26	0.3	-4.8041668	-12.3704996	2970	HD OFF
22:55:44	-4.80410	-12.37090	2995	26	0.3	-4.8039999	-12.3704996	2967	trying to take a temperature measurement with 8 channel logger
23:04:42	-4.80415	-12.37092	2995	26	0.2	-4.8041668	-12.3704996	2973	stowing away broken slurp gun first
23:09:25	-4.80407	-12.37085	2995	26	0.2	-4.8041668	-12.3703327	2970	HD ON
23:11:11	-4.80417	-12.37095	2995	27	0.2	-4.8041668	-12.3703327	2962	trying to place 8 channel logger vertically
23:11:19	-4.80412	-12.37092	2995	26	0.2	-4.8041668	-12.3703327	2985	looking good
23:11:30	-4.80415	-12.37095	2995	26	0.2	-4.8041668	-12.3703327	2967	temperates recording
23:11:48	-4.80412	-12.37100	2995	26	0.2	-4.8041668	-12.3703327	2967	uppermost sensor is still out of mussel bed
23:12:33	-4.80413	-12.37097	2995	26	0.2	-4.8041668	-12.3703327	2968	maximum temperature is 14,9
23:13:37	-4.80410	-12.37095	2995	26	0.2	-4.8041668	-12.3703327	2971	T1 14,4; T2 11,5; T3 11,78; T4 12,27; T5 11,29; T6 11,99; T7 11,32; T8 10,8
23:13:39	-4.80410	-12.37095	2995	26	0.2	-4.8041668	-12.3703327	2971	still image
23:13:52	-4.80412	-12.37092	2995	26	0.2	-4.8041668	-12.3703327	2974	still image with 8 channel logger
23:13:56	-4.80412	-12.37092	2995	--	--	-4.8041668	-12.3703327	2967	still image
23:14:12	-4.80415	-12.37090	2995	26	0.2	-4.8041668	-12.3703327	2965	another still image of 8 channel logger
23:15:00	-4.80413	-12.37095	2995	26	0.2	-4.8041668	-12.3704996	2969	max T 14,37
23:17:12	-4.80423	-12.37088	2995	26	0.2	-4.8041668	-12.3704996	2979	HD OFF
23:17:19	-4.80423	-12.37088	2995	26	0.2	-4.8041668	-12.3704996	2978	terminate
23:18:01	-4.80417	-12.37095	2995	26	0.2	-4.8041668	-12.3704996	2966	T1 14,36; T2 9,99; T3 11,59; T4 12,32; T5 11,47; T6 12,25; T7 11,62; T8 11,64
23:18:45	-4.80415	-12.37093	2995	26	0.2	-4.8041668	-12.3704996	2967	place tip of 8 channel logger at mussel sampling spot
23:19:05	-4.80408	-12.37112	2995	26	0.2	-4.8041668	-12.3704996	2968	temperature recording
23:19:40	-4.80427	-12.37103	2995	26	0.2	-4.8041668	-12.3704996	2971	sample_16
23:19:54	-4.80425	-12.37100	2995	26	0.2	-4.8041668	-12.3704996	2976	temperature measurement as sample
23:20:45	-4.80413	-12.37093	2995	26	0.2	-4.8041668	-12.3704996	2969	T at tip between 5.5 and 6.5°C
23:21:32	-4.80415	-12.37095	2995	26	0.2	-4.8041668	-12.3704996	2975	temperatures variable
23:21:55	-4.80410	-12.37097	2995	26	0.2	-4.8041668	-12.3704996	2978	terminate temperature recording
23:22:22	-4.80408	-12.37097	2995	25	0.2	-4.8041668	-12.3704996	2970	moving 8 channel logger back into holding bin
23:34:47	-4.80413	-12.37095	2995	299	0.2	-4.8041668	-12.3704996	2973	HD ON
23:35:33	-4.80417	-12.37092	2995	299	0.2	-4.8041668	-12.3704996	2969	push trigger on top of DIE FAST 2, this will move mussels into pot
23:40:31	-4.80420	-12.37095	2995	299	0.2	-4.8039999	-12.3704996	2970	pushing trigger, but too many mussels block entrance to pot
23:43:14	-4.80410	-12.37095	2995	299	0.2	-4.8039999	-12.3706675	2970	HD OFF
23:47:40	-4.80413	-12.37100	2995	298	0.2	-4.8039999	-12.3706675	3119	moving both DIE FASTs on the porch
23:59:38	-4.80412	-12.37102	2995	299	0.2	-4.8039999	-12.3703327	2972	OFF THE BOTTOM
01:18:45	-4.80278	-12.37170	40	--	--	-4.8039999	-12.3695002	2966	ON DECK

Cruise: MAR SOUTH V
Date: 23.04.2009
Station: M78-2_308ROV
Targets: Turtle Pits, transit to Sisters Peak, Golden Valley

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:22:06	-4.80972	-12.37545	435	321	37.3	-4.8101668	-12.3739996	2972	IN THE WATER
14:14:00	-4.80947	-12.37393	2500	114	37.3	-4.8101668	-12.3730001	2969	ROV at 2500m,descending without problems
14:14:14	-4.80953	-12.37388	2506	114	37.3	-4.8101668	-12.3730001	2969	testing KIPD pump
14:21:33	-4.80925	-12.37393	2821	140	37.3	-4.8101668	-12.3730001	2968	ship positioned 80m SE of One Boat
14:22:08	-4.80927	-12.37393	2834	140	37.3	-4.8101668	-12.3730001	2969	mission: sample Turtle Pits and Sisters Peak; map geology in TRansit and visit cones north of Turtle Pits
14:25:06	-4.80955	-12.37385	2899	111	37.3	-4.8101668	-12.3730001	2972	2900m; ROV descending, OK
14:26:42	-4.80957	-12.37355	2951	111	37.3	-4.8101668	-12.3730001	2970	altimeter kicks in, 40m above bottom
14:29:29	-4.80948	-12.37370	2981	111	8.8	-4.8101668	-12.3730001	2969	8m above bottom, sheet flows with scattered mussels
14:35:00	-4.80948	-12.37368	2984	203	4.1	-4.8101668	-12.3730001	2969	in tectonized area with narrow fissure,moving south
14:35:24	-4.80947	-12.37377	2984	201	4.4	-4.8101668	-12.3730001	2971	at Msarker M3, northern entrence to Turtle Pits
14:36:21	-4.80958	-12.37375	2983	143	5.6	-4.8101668	-12.3730001	2968	HD ON
14:36:38	-4.80957	-12.37383	2983	144	5.5	-4.8101668	-12.3730001	2968	still image
14:37:02	-4.80963	-12.37372	2983	143	5.7	-4.8101668	-12.3730001	2970	HD OFF
14:37:40	-4.80960	-12.37378	2983	144	5.6	-4.8101668	-12.3730001	2971	at Pinoccio
14:37:43	-4.80960	-12.37378	2983	144	5.5	-4.8101668	-12.3730001	2971	still image
14:38:44	-4.80955	-12.37383	2984	148	4.9	-4.8101668	-12.3730001	2972	no change in overall appearence of the structure
14:39:01	-4.80957	-12.37377	2983	145	4.9	-4.8101668	-12.3730001	2970	moving south along western boundary of the field towards Stalagmite
14:39:16	-4.80967	-12.37362	2986	142	2.4	-4.8101668	-12.3730001	2969	HD ON
14:40:29	-4.80970	-12.37373	2984	118	5	-4.8101668	-12.3730001	2970	moving upwards at Stalagmite,no change to 2005
14:40:34	-4.80970	-12.37373	2984	118	4.9	-4.8101668	-12.3730001	2970	still image
14:40:52	-4.80958	-12.37380	2983	118	5	-4.8101668	-12.3730001	2970	still image
14:41:01	-4.80958	-12.37380	2984	118	4.9	-4.8101668	-12.3730001	2970	HD OFF
14:42:13	-4.80960	-12.37372	2984	166	5	-4.8101668	-12.3730001	2971	at base of Two boats 2985m + 5m altitude (=2990m)
14:43:34	-4.80957	-12.37382	2983	149	4.5	-4.8101668	-12.3730001	2970	smoke is blowing our way (NE) moving around the structure
14:47:56	-4.80987	-12.37387	2984	172	4.8	-4.8101668	-12.3730001	2971	top of the mound at 2983m (mound is 13m high)
14:48:10	-4.80983	-12.37393	2984	--	--	-4.8101668	-12.3730001	2967	sulfide talus on sheet flow, scatterd mussels
14:48:32	-4.80978	-12.37387	2984	172	5	-4.8101668	-12.3730001	2972	large sulfide boulders
14:49:33	-4.80988	-12.37390	2984	174	5	-4.8101668	-12.3730001	2969	still image
14:50:51	-4.80987	-12.37378	2983	123	5.2	-4.8101668	-12.3730001	2970	turning eastward stowards One Boat
14:51:17	-4.80987	-12.37382	2983	111	5.2	-4.8101668	-12.3730001	2972	at base of One Boat (2984 + 5m = 2899m)
14:52:28	-4.80992	-12.37377	2984	71	5.3	-4.8101668	-12.3730001	2975	base of smoker at 2985
14:52:37	-4.80993	-12.37370	2984	71	4.8	-4.8101668	-12.3730001	2971	HD ON
14:54:25	-4.80995	-12.37378	2980	68	9.7	-4.8101668	-12.3730001	2969	top at 2980m, smoker is 5 m high
14:54:47	-4.81003	-12.37372	2980	46	9.6	-4.8101668	-12.3730001	2970	HD OFF
14:55:04	-4.80995	-12.37367	2981	1	7	-4.8101668	-12.3730001	2969	HD ON
14:56:21	-4.81000	-12.37352	2981	16	7.5	-4.8101668	-12.3730001	2969	HD OFF
14:58:49	-4.80993	-12.37367	2981	1	7.1	-4.8101668	-12.3730001	2971	HD ON
14:59:15	-4.80995	-12.37368	2981	1	7.3	-4.8101668	-12.3730001	2972	HD OFF
15:00:05	-4.80993	-12.37367	2981	1	7.4	-4.8101668	-12.3730001	2968	on top of chimney, difficult to find landing spot
15:05:28	-4.81002	-12.37377	2985	75	4.2	-4.8103328	-12.3730001	2969	waiting on west side of smoker until the ship moved
15:09:47	-4.80990	-12.37368	2980	4	8.7	-4.8105001	-12.3730001	2966	cable is close to the structured and became tangled near the top, will relocate ship 40m to the east
15:12:49	-4.80995	-12.37375	2978	58	11.6	-4.8105001	-12.3730001	2972	the current seems to be stronger than earlier; kreeping smoke is displace horizontally towards NW
15:16:22	-4.80992	-12.37363	2981	34	7.8	-4.8105001	-12.3728333	2980	still image
15:16:53	-4.80990	-12.37367	2981	34	7.9	-4.8105001	-12.3726673	2967	still image
15:20:21	-4.81005	-12.37372	2982	68	7.6	-4.8105001	-12.3726673	2966	still trying to get the cable out of the danger zone
15:35:21	-4.80993	-12.37378	2982	24	7.8	-4.8105001	-12.3726673	2970	further away from the structure,in SW, approaching again
15:35:43	-4.80988	-12.37378	2982	24	7.8	-4.8105001	-12.3726673	2971	at SSW side of the srtucture, trying to reach to the orifice
15:38:19	-4.80990	-12.37373	2981	24	7.7	-4.8105001	-12.3726673	2968	HD ON
15:41:05	-4.80992	-12.37370	2981	24	7.8	-4.8103328	-12.3726673	2968	HD OFF
15:41:44	-4.80998	-12.37368	2981	24	7.7	-4.8103328	-12.3726673	2975	opening of the orifice, worked well
15:41:58	-4.80995	-12.37365	2981	24	7.8	-4.8103328	-12.3726673	2969	preparing to take KIPS handle out
15:44:18	-4.80995	-12.37368	2981	24	7.8	-4.8105001	-12.3726673	2969	removing KIPS
15:46:07	-4.80992	-12.37367	2981	24	7.7	-4.8105001	-12.3726673	2971	approachin orifice with nossel
15:48:37	-4.80993	-12.37372	2981	23	7.8	-4.8105001	-12.3726673	2970	362° 376°,
15:50:36	-4.80988	-12.37370	2981	24	7.7	-4.8103328	-12.3726673	2964	364, 374, 397, 404,
15:52:15	-4.80993	-12.37372	2981	23	7.8	-4.8103328	-12.3726673	2969	very fragile top, pieceses falling off all the time
15:54:21	-4.80997	-12.37365	2982	24	7.3	-4.8103328	-12.3726673	2968	HD ON
15:54:25	-4.80997	-12.37365	2982	24	7.2	-4.8105001	-12.3726673	2968	the entire structure is shaking from the fluid pressure
15:54:47	-4.80993	-12.37370	2982	24	7.2	-4.8105001	-12.3726673	2970	HD OFF
15:57:16	-4.80995	-12.37363	2982	23	7.1	-4.8105001	-12.3726673	2966	HD ON
15:59:09	-4.80992	-12.37372	2982	24	7.1	-4.8103328	-12.3726673	2969	HD OFF
15:59:37	-4.80992	-12.37365	2982	24	7.2	-4.8103328	-12.3726673	2967	280, difficult to get stable tempretaure within this orifice

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
16:01:22	-4.80992	-12.37372	2982	26	7.2	-4.8105001	-12.3726673	2968	still image
16:01:27	-4.80995	-12.37370	2982	--	--	-4.8105001	-12.3726673	2972	still image
16:07:23	-4.80957	-12.37352	2982	353	5	-4.8103328	-12.3726673	2968	sheet flow, slightly sedimented
16:07:56	-4.80950	-12.37358	2986	360	2.6	-4.8101668	-12.3726673	2970	east of Turtle Pits flying north to volcanic cone (220m NNW) from here
16:08:33	-4.80947	-12.37360	2986	335	2.5	-4.8101668	-12.3726673	2972	sheet flow, slightly sedimented
16:09:13	-4.80942	-12.37365	2985	23	3.9	-4.8101668	-12.3726673	2969	sheet flow, slightly sedimented
16:09:16	-4.80933	-12.37368	2985	22	4.4	-4.8101668	-12.3726673	2971	inactive chimney
16:09:44	-4.80930	-12.37370	2987	1	4	-4.8101668	-12.3726673	2969	northern end of Turtle Pits,flying north
16:11:05	-4.80905	-12.37372	2985	343	3.6	-4.8099999	-12.3726673	2969	narrowing fissure, sheet flows on both sides
16:11:11	-4.80902	-12.37378	2986	344	3.6	-4.8099999	-12.3726673	2969	sheet flow, slightly sedimented
16:11:14	-4.80902	-12.37378	2985	342	3.7	-4.8099999	-12.3726673	2969	sheet flow, slightly sedimented
16:11:21	-4.80895	-12.37380	2986	343	3.6	-4.8099999	-12.3726673	2968	hackly lava
16:12:13	-4.80887	-12.37390	2987	257	3.1	-4.8099999	-12.3726673	2969	Fe-staining
16:12:20	-4.80887	-12.37392	2987	269	3	-4.8099999	-12.3726673	2969	pressure ridge
16:14:35	-4.80883	-12.37395	2988	282	2.5	-4.809833	-12.3726673	2968	weight from something
16:15:28	-4.80885	-12.37392	2988	356	2.3	-4.809833	-12.3726673	2972	hydrothermal sediment
16:17:16	-4.80872	-12.37397	2991	18	0.4	-4.8096671	-12.3726673	2975	130 NW of One Boat; Fe-oxide mats in jumbled sheet flows
16:18:34	-4.80870	-12.37400	2991	18	0.4	-4.8096671	-12.3726673	2969	still image
16:18:35	-4.80870	-12.37400	2991	18	0.4	-4.8096671	-12.3726673	2969	still image
16:18:36	-4.80870	-12.37400	2991	18	0.4	-4.8096671	-12.3726673	2969	HD ON
16:18:58	-4.80872	-12.37400	2991	18	0.4	-4.8096671	-12.3726673	2969	HD OFF
16:19:57	-4.80862	-12.37407	2990	343	1.8	-4.8095002	-12.3726673	2967	sheet flow, slightly sedimented
16:20:39	-4.80855	-12.37417	2989	2	3.6	-4.8095002	-12.3726673	2968	sheet flow, slightly sedimented
16:20:50	-4.80852	-12.37413	2989	2	3.9	-4.8095002	-12.3726673	2970	nice striations
16:21:16	-4.80848	-12.37415	2992	1	1.2	-4.8095002	-12.3726673	2969	sheet flow, slightly sedimented
16:21:41	-4.80832	-12.37357	2990	2	2.7	-4.8095002	-12.3726673	2969	contact to hackly lava
16:23:20	-4.80827	-12.37420	2987	349	5	-4.8095002	-12.3726673	2975	came up 11m,now back at the seafloor in hackly lava
16:23:35	-4.80818	-12.37438	2991	350	1.5	-4.8095002	-12.3726673	2969	hackly lava
16:23:47	-4.80815	-12.37460	2990	349	1.6	-4.8093328	-12.3726673	2970	contact to sheet flows
16:25:46	-4.80797	-12.37442	2991	2	2.8	-4.8093328	-12.3726673	2968	lobate flow, slightly sedimented
16:25:57	-4.80793	-12.37440	2992	9	2.1	-4.8093328	-12.3726673	2972	still image
16:26:30	-4.80792	-12.37442	2992	9	2.1	-4.8093328	-12.3726673	2970	lobate flows with skylighhts
16:26:32	-4.80792	-12.37442	2992	9	2.2	-4.8093328	-12.3726673	2970	still image
16:26:40	-4.80792	-12.37442	2992	8	2	-4.8091669	-12.3726673	2971	severalfotos taken
16:27:49	-4.80788	-12.37420	2992	338	2.2	-4.8091669	-12.3726673	2968	HD ON
16:29:34	-4.80770	-12.37447	2988	27	5.4	-4.8091669	-12.3726673	2968	HD OFF
16:29:47	-4.80777	-12.37438	2988	38	5.4	-4.8091669	-12.3726673	2970	Fe-oxide mound with old chimneys
16:30:39	-4.80770	-12.37445	2989	52	1.5	-4.809	-12.3726673	2971	at 2987m is the top of the mound
16:30:44	-4.80770	-12.37447	2989	53	2.6	-4.809	-12.3726673	2969	Crab
16:31:31	-4.80783	-12.37435	2992	359	1.9	-4.809	-12.3726673	2968	HD OFF
16:32:07	-4.80773	-12.37435	2993	343	1.9	-4.809	-12.3726673	2969	2994 is the depth of the base
16:36:52	-4.80762	-12.37447	2987	169	7.1	-4.809	-12.3726673	2975	at top again trying to prepare to take a sample
16:37:49	-4.80757	-12.37420	2987	156	6.7	-4.8088331	-12.3728333	2981	Fe-oxide chimney shows diffuse fluid outflow
16:38:17	-4.80780	-12.37442	2988	156	6.2	-4.8088331	-12.3728333	2969	HD ON
16:38:45	-4.80763	-12.37443	2988	156	6.2	-4.8088331	-12.3728333	2974	HD OFF
16:40:53	-4.80758	-12.37447	2988	216	6.4	-4.8086672	-12.3726673	2969	leaving this mound and flying to next target 10 away
16:41:20	-4.80767	-12.37447	2988	216	5.3	-4.8086672	-12.3726673	2973	HD ON
16:41:27	-4.80772	-12.37450	2988	219	5.3	-4.8086672	-12.3726673	2972	sulfide talus on slope of mound
16:42:14	-4.80765	-12.37458	2986	225	5.5	-4.8084998	-12.3726673	2971	HD OFF
16:43:21	-4.80772	-12.37435	2985	280	5.7	-4.8084998	-12.3726673	2972	central crater (visible on ABE bathymetry), diffuse fluid flow
16:45:44	-4.80767	-12.37445	2985	266	6.2	-4.8086672	-12.3726673	2969	still image
16:46:52	-4.80770	-12.37458	2986	243	2	-4.8086672	-12.3726673	2970	still image
16:47:27	-4.80773	-12.37457	2987	250	1.8	-4.8086672	-12.3726673	2971	still image
16:47:31	-4.80773	-12.37457	2987	251	1.8	-4.8086672	-12.3726673	2971	HD ON
16:47:50	-4.80773	-12.37455	2986	240	3.6	-4.8086672	-12.3726673	2974	HD OFF
16:52:35	-4.80772	-12.37455	2990	161	3	-4.8084998	-12.3728333	2969	preparing for sampling
17:02:30	-4.80770	-12.37460	2990	163	2.4	-4.8084998	-12.3730001	2967	opening sample box
17:02:41	-4.80768	-12.37453	2990	163	2.8	-4.8084998	-12.3730001	2973	grabed sampled
17:02:54	-4.80767	-12.37455	2990	--	--	-4.8084998	-12.3730001	2972	sample_1
17:03:53	-4.80772	-12.37462	2990	163	2.3	-4.8084998	-12.3730001	2972	sample 308ROV-1 (Fe-stained sulfide)
17:04:31	-4.80770	-12.37453	2990	163	2.5	-4.8084998	-12.3730001	2972	placed in sample box
17:04:38	-4.80770	-12.37457	2990	163	2.5	-4.8084998	-12.3730001	2972	closing tray
17:08:58	-4.80772	-12.37457	2990	163	2.5	-4.8084998	-12.3730001	2972	still image
17:09:04	-4.80770	-12.37460	2990	163	2.5	-4.8084998	-12.3730001	2971	still image
17:11:47	-4.80760	-12.37460	2984	204	6.9	-4.8084998	-12.3730001	2969	lift off, turning north
17:13:21	-4.80760	-12.37455	2990	336	5.3	-4.8084998	-12.3730001	2980	next sulfide edifice ahead2991 + 4m altitude = base of structure
17:13:38	-4.80755	-12.37458	2992	337	4.6	-4.8084998	-12.3730001	2974	HD ON
17:14:02	-4.80750	-12.37465	2990	337	5.7	-4.8084998	-12.3730001	2973	still image
17:14:25	-4.80752	-12.37462	2988	350	7.4	-4.8084998	-12.3730001	2973	still image
17:14:35	-4.80752	-12.37457	2987	351	7.4	-4.8084998	-12.3730001	2972	still image
17:14:51	-4.80755	-12.37458	2987	329	7.4	-4.8084998	-12.3730001	2970	active chimney
17:14:57	-4.80753	-12.37455	2986	329	7.3	-4.8084998	-12.3730001	2970	Fe-oxide chimney
17:15:01	-4.80752	-12.37457	2987	331	7.2	-4.8084998	-12.3730001	2970	metalliferous sediment
17:15:02	-4.80752	-12.37457	2987	333	7.2	-4.8084998	-12.3730001	2970	sulfide mound
17:15:21	-4.80750	-12.37460	2988	339	6.3	-4.8084998	-12.3730001	2988	HD OFF
17:16:25	-4.80753	-12.37458	2991	318	3.8	-4.8084998	-12.3730001	2983	inspecting this mound from the east; hydrothermal sediment in between the two structures
17:16:28	-4.80753	-12.37458	2991	318	3.9	-4.8084998	-12.3730001	2971	still image
17:16:58	-4.80745	-12.37462	2991	329	4.4	-4.8084998	-12.3730001	2971	second mound on the mapis laso hydrothermal!
17:17:45	-4.80742	-12.37463	2995	16	2.6	-4.8084998	-12.3730001	2971	sheet flow, slightly sedimented

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:19:08	-4.80730	-12.37457	2992	50	5.2	-4.8084998	-12.3730001	2971	HD ON
17:19:27	-4.80727	-12.37457	2991	52	5.8	-4.8084998	-12.3730001	2969	arrived at next mound; Fe-oxides, base at 2992m
17:19:41	-4.80725	-12.37452	2991	53	5.5	-4.8084998	-12.3730001	2970	several still images on ascend to the top
17:21:12	-4.80717	-12.37460	2987	53	4.6	-4.8083329	-12.3730001	2972	still image
17:21:18	-4.80717	-12.37453	2987	54	5.4	-4.8083329	-12.3730001	2972	HD OFF
17:21:50	-4.80720	-12.37452	2987	48	5.4	-4.8083329	-12.3730001	2979	thrid mound consists also entirely of hydrothermal material
17:24:05	-4.80717	-12.37438	2994	89	2.2	-4.8080001	-12.373167	2972	contact between hydrothermal mound and sheet flows
17:24:11	-4.80717	-12.37438	2994	89	1.9	-4.8080001	-12.373167	2972	sheet flow, slightly sedimented
17:24:22	-4.80708	-12.37442	2995	89	1.7	-4.8080001	-12.373167	2972	sheet flow, < 50 % sediment
17:24:33	-4.80710	-12.37438	2995	90	1.2	-4.8080001	-12.373167	2974	sheet flow, > 50 % sediment
17:24:50	-4.80708	-12.37435	2995	89	1.5	-4.8080001	-12.373167	2972	sheet flow, > 50 % sediment
17:25:07	-4.80713	-12.37425	2995	88	1.6	-4.8078332	-12.373167	2973	jumbled lava
17:25:31	-4.80703	-12.37427	2994	88	2.5	-4.8078332	-12.373167	2974	jumbled lava
17:26:42	-4.80702	-12.37417	2993	110	2	-4.8076668	-12.373333	2973	jumbled lava
17:27:09	-4.80697	-12.37412	2993	104	2.2	-4.8076668	-12.373167	2974	jumbled lava
17:27:25	-4.80702	-12.37405	2993	104	1.9	-4.8076668	-12.373167	2973	jumbled lava
17:27:27	-4.80702	-12.37405	2993	105	1.9	-4.8076668	-12.373167	2974	moving east now, strong current displaces us to the north,
17:27:37	-4.80693	-12.37405	2993	105	1.6	-4.8076668	-12.373333	2973	contact to sheet flows
17:27:46	-4.80690	-12.37403	2994	104	1.7	-4.8076668	-12.373333	2974	sheet flow, slightly sedimented
17:28:18	-4.80688	-12.37387	2994	104	1.2	-4.8076668	-12.373333	2970	sheet flow, slightly sedimented
17:28:35	-4.80700	-12.37377	2994	104	1.2	-4.8074999	-12.373333	2976	sheet flow, < 50 % sediment
17:28:55	-4.80703	-12.37370	2994	--	--	-4.8074999	-12.373333	2977	sheet flow, < 50 % sediment
17:29:56	-4.80702	-12.37357	2993	103	1.5	-4.8074999	-12.373167	2974	still image
17:30:13	-4.80695	-12.37357	2993	98	1.6	-4.8074999	-12.373167	2970	contact to tectonized area (but same flow unit)
17:30:27	-4.80695	-12.37357	2993	98	1.6	-4.8074999	-12.373333	2974	lobate flow, slightly sedimented
17:30:45	-4.80707	-12.37358	2992	98	1.7	-4.8074999	-12.373333	2973	collapse pit
17:30:57	-4.80697	-12.37347	2992	98	1.7	-4.8074999	-12.373333	2974	collapse pit
17:32:05	-4.80703	-12.37320	2992	102	1.9	-4.8074999	-12.373167	2971	eruptive centers, (?) with drainback features standing high above the surrounding area
17:32:37	-4.80693	-12.37310	2990	102	3.6	-4.8074999	-12.373167	2976	complicated change between jumbled, sheets and lobate surfaces
17:34:38	-4.80768	-12.37293	2990	73	2.3	-4.8074999	-12.3725004	2975	white patches ahead, (ship has problems, we need to wait
17:34:44	-4.80700	-12.37298	2990	73	2.2	-4.8074999	-12.3725004	2973	mussel patch
17:35:28	-4.80670	-12.37300	2991	74	0.4	-4.807333	-12.3723326	2976	diffuse outflow
17:35:40	-4.80692	-12.37315	2991	74	0.3	-4.807333	-12.3723326	2973	still image
17:37:40	-4.80675	-12.37262	2991	73	0.3	-4.807333	-12.3723326	2973	HD OFF
17:39:02	-4.80693	-12.37298	2990	105	2	-4.807333	-12.3723326	2974	Crab
17:39:13	-4.80683	-12.37295	2990	102	2.1	-4.807333	-12.3723326	2977	mussel beds within tectonized area, several patches, clear tectonic control
17:39:37	-4.80693	-12.37295	2990	102	1.9	-4.807333	-12.3723326	2973	still image
17:39:43	-4.80693	-12.37295	2990	101	1.8	-4.807333	-12.3723326	2973	lobate flows with skylights
17:40:20	-4.80675	-12.37300	2990	102	1.6	-4.807333	-12.3723326	2977	lobate flow, slightly sedimented
17:41:57	-4.80683	-12.37275	2991	155	1.4	-4.8071671	-12.3721666	2971	coming into first larger fissure
17:42:46	-4.80648	-12.37292	2992	97	0.9	-4.8071671	-12.3719997	2974	another dive weight from ABE dive 173
17:44:55	-4.80682	-12.37267	2991	88	1.6	-4.8070002	-12.3716669	2970	HD OFF
17:45:02	-4.80687	-12.37265	2991	87	1.4	-4.8070002	-12.3716669	2970	the fissured part is HIGHER than the surrounding area
17:45:16	-4.80672	-12.37260	2990	89	1.2	-4.8070002	-12.3716669	2974	large drainage areas, lava pillars everywhere
17:47:12	-4.80665	-12.37247	2990	82	2	-4.8068328	-12.3715	2971	collapse pit
17:47:13	-4.80665	-12.37247	2990	82	1.8	-4.8068328	-12.3715	2971	lava pillar
17:47:45	-4.80672	-12.37248	2990	82	1.8	-4.8066669	-12.3713331	2970	still image
17:47:51	-4.80673	-12.37262	2990	82	2.1	-4.8066669	-12.3713331	2970	still image
17:48:50	-4.80673	-12.37252	2989	82	3	-4.8066669	-12.3713331	2970	abudant skylights, still moving east
17:49:03	-4.80667	-12.37245	2989	82	3.1	-4.8066669	-12.3713331	2970	collapse pit
17:52:55	-4.80652	-12.37225	2990	100	2.1	-4.8066669	-12.3713331	2969	Crab
17:54:11	-4.80653	-12.37213	2991	92	1.1	-4.8066669	-12.3713331	2972	lobate flow, slightly sedimented
17:54:51	-4.80648	-12.37203	2991	64	1.9	-4.8066669	-12.3713331	2970	fish
17:55:42	-4.80638	-12.37215	2993	2	1.4	-4.8066669	-12.3713331	2968	sheet flows with sediment ponds
17:56:10	-4.80633	-12.37222	2993	2	1.1	-4.8066669	-12.3713331	2973	jumbled lava
17:57:04	-4.80618	-12.37220	2993	350	1.6	-4.8066669	-12.3713331	2973	collapsed smalld dome
17:57:35	-4.80615	-12.37215	2993	352	1.4	-4.8066669	-12.3713331	2970	jumbled lava
17:58:20	-4.80598	-12.37228	2994	328	1.4	-4.8066669	-12.3713331	2971	still image
17:58:27	-4.80598	-12.37228	2994	324	1.6	-4.8066669	-12.3713331	2969	still image
17:58:53	-4.80597	-12.37230	2994	307	1.2	-4.8066669	-12.3713331	2971	drain structure at wall
17:59:43	-4.80587	-12.37235	2994	21	1.1	-4.8065	-12.3713331	2974	jumbled lava
18:00:18	-4.80577	-12.37232	2993	21	1.4	-4.8065	-12.3713331	2972	HD ON
18:00:30	-4.80573	-12.37232	2993	21	1.2	-4.8065	-12.3713331	2972	star
18:00:43	-4.80577	-12.37230	2993	21	0.7	-4.8065	-12.3713331	2971	still image
18:00:58	-4.80573	-12.37225	2993	20	1.2	-4.8065	-12.3711672	2970	HD OFF
18:02:49	-4.80558	-12.37227	2993	20	1.6	-4.8061671	-12.3711672	2969	left lobate flow,right: jumbled lava
18:03:29	-4.80560	-12.37233	2993	2	1.3	-4.8060002	-12.3711672	2970	fish
18:03:47	-4.80570	-12.37232	2993	1	1.2	-4.8060002	-12.3711672	2965	Holothurian
18:04:23	-4.80555	-12.37223	2994	1	0.4	-4.8058329	-12.3711672	2970	still image
18:04:47	-4.80562	-12.37238	2994	1	0.4	-4.8058329	-12.3711672	2971	apparent whith spot in jumbled lava
18:05:08	-4.80562	-12.37233	2994	1	0.4	-4.8058329	-12.3711672	2965	sediment
18:05:19	-4.80563	-12.37237	2993	10	1.8	-4.8056669	-12.3711672	2969	fish
18:05:51	-4.80555	-12.37235	2993	23	1.5	-4.8056669	-12.3711672	2968	jumbled lava
18:06:39	-4.80547	-12.37223	2993	24	1.9	-4.8055	-12.3711672	2962	lobates,collapsed
18:07:17	-4.80553	-12.37225	2992	23	2.2	-4.8053331	-12.3710003	2965	lava pond with wall(right) covered with lobate
18:07:38	-4.80545	-12.37228	2994	64	2.2	-4.8053331	-12.3710003	2968	hollow tube
18:07:51	-4.80555	-12.37227	2994	64	2.1	-4.8053331	-12.3710003	2964	still image
18:08:16	-4.80552	-12.37232	2994	64	1.8	-4.8053331	-12.3710003	2967	still image
18:08:24	-4.80545	-12.37233	2994	64	2.3	-4.8051672	-12.3710003	2974	still image

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
18:09:11	-4.80543	-12.37233	2991	64	3	-4.8051672	-12.3710003	2974	collappsed lobes
18:09:32	-4.80537	-12.37230	2991	60	2.9	-4.8051672	-12.3710003	2964	lobate flow, < 50 % sediment
18:09:48	-4.80527	-12.37227	2992	60	1.9	-4.8049998	-12.3710003	2974	lobate flow, < 50 % sediment
18:10:18	-4.80528	-12.37233	2993	60	1.4	-4.8049998	-12.3710003	2955	sink with sediments
18:11:00	-4.80523	-12.37238	2993	60	3.5	-4.8049998	-12.3710003	2960	fat lava tubes, partly hollow
18:12:25	-4.80502	-12.37217	2992	67	4.3	-4.8048329	-12.3710003	2958	drain strucktures, lava nappes
18:13:23	-4.80502	-12.37222	2994	85	2.3	-4.8048329	-12.3710003	2978	layers of famll sheet flows stacked
18:13:24	-4.80498	-12.37220	2994	85	2.5	-4.8048329	-12.3710003	2978	still image
18:13:53	-4.80492	-12.37218	2992	64	3.7	-4.8048329	-12.3710003	2969	many collapsed tubes
18:14:33	-4.80483	-12.37207	2993	64	2.6	-4.8048329	-12.3710003	2973	sediments always present,
18:14:55	-4.80472	-12.37200	2993	62	3.1	-4.8048329	-12.3710003	2972	another pile of stacked sheddts;
18:15:05	-4.80472	-12.37207	2992	62	2.7	-4.8048329	-12.3710003	2973	lava pillars
18:15:40	-4.80465	-12.37200	2992	61	3.1	-4.8048329	-12.3710003	2976	lobate flow, slightly sedimented
18:15:44	-4.80465	-12.37200	2991	60	3.5	-4.8048329	-12.3710003	2976	lobate flow, slightly sedimented
18:16:34	-4.80458	-12.37200	2992	61	2.6	-4.8048329	-12.3710003	2968	climbing up a hill
18:16:42	-4.80445	-12.37192	2992	61	2.6	-4.8048329	-12.3710003	2971	pillow lava, unsedimented
18:17:08	-4.80440	-12.37193	2990	60	4.5	-4.8048329	-12.3710003	2981	climbing a small pillow mound
18:17:42	-4.80432	-12.37187	2990	60	3.6	-4.8048329	-12.3710003	2964	pillow lava, slightly sedimented
18:18:22	-4.80425	-12.37180	2992	61	1.7	-4.8049998	-12.3710003	2967	sediment spots
18:19:18	-4.80417	-12.37167	2990	83	3.4	-4.8049998	-12.3710003	2978	pillow lava, slightly sedimented
18:20:14	-4.80423	-12.37148	2990	97	3.9	-4.8049998	-12.3710003	2972	large tube
18:21:11	-4.80418	-12.37135	2991	72	3.4	-4.8049998	-12.3710003	2970	nice tubes, parallel
18:21:39	-4.80412	-12.37127	2992	58	2.4	-4.8049998	-12.3710003	2971	jumbled lava
18:22:32	-4.80407	-12.37132	2992	8	2	-4.8049998	-12.3710003	2970	fish
18:22:55	-4.80408	-12.37130	2993	288	2.4	-4.8048329	-12.3710003	2968	hackley lava
18:23:00	-4.80408	-12.37130	2993	288	2.6	-4.8048329	-12.3710003	2977	fish
18:24:15	-4.80402	-12.37155	2993	329	1.3	-4.8048329	-12.3710003	2965	mussel patch
18:24:25	-4.80402	-12.37153	2994	329	0.7	-4.8048329	-12.3710003	2969	still image
18:24:34	-4.80402	-12.37153	2994	333	0.6	-4.8048329	-12.3710003	2969	shimmering water
18:24:41	-4.80400	-12.37160	2993	333	0.9	-4.8048329	-12.3710003	2966	HD ON
18:25:17	-4.80398	-12.37158	2992	355	2.2	-4.8048329	-12.3710003	2973	many mussels patches in the back
18:25:36	-4.80397	-12.37153	2993	340	2	-4.8048329	-12.3710003	2967	mussel patch
18:25:38	-4.80397	-12.37153	2993	340	2	-4.804667	-12.3710003	2967	HD OFF
18:26:31	-4.80388	-12.37167	2993	344	2.1	-4.804667	-12.3710003	2973	next patch in the back
18:27:00	-4.80402	-12.37172	2994	3	1.8	-4.8045001	-12.3710003	2971	small hill completley covered by mussels
18:27:18	-4.80390	-12.37165	2994	3	1.1	-4.8045001	-12.3710003	2972	still image
18:29:04	-4.80367	-12.37175	2992	17	4.4	-4.8041668	-12.3710003	2973	hackly lava
18:29:36	-4.80357	-12.37170	2994	16	2.8	-4.8041668	-12.3710003	2969	lobate flow, slightly sedimented
18:29:58	-4.80335	-12.37177	2994	18	3.1	-4.8039999	-12.3710003	2980	pile of lava sheets
18:30:00	-4.80335	-12.37177	2993	--	--	-4.8039999	-12.3710003	2980	fish
18:30:43	-4.80340	-12.37155	2993	17	3.9	-4.8039999	-12.3710003	2974	linear sedimentary structures
18:30:59	-4.80347	-12.37168	2993	17	3.9	-4.803833	-12.3710003	2977	sheet flows came from the right
18:31:24	-4.80327	-12.37170	2993	6	3.5	-4.803833	-12.3710003	2973	hackly lava ridge
18:31:46	-4.80337	-12.37170	2991	18	4.5	-4.803833	-12.3710003	2980	marker visible
18:32:09	-4.80327	-12.37170	2991	3	4.6	-4.8036671	-12.3710003	2974	bacterial mat, patchy
18:32:22	-4.80322	-12.37178	2991	355	4.4	-4.8036671	-12.3710003	2976	sisters Peak reached
18:35:33	-4.80323	-12.37177	2993	306	2.4	-4.8033328	-12.3710003	2972	basis at 2993 meter
18:35:57	-4.80318	-12.37177	2993	306	2.2	-4.8033328	-12.3710003	2977	HD ON
18:36:54	-4.80315	-12.37180	2989	303	6.4	-4.8033328	-12.3710003	2967	flying from teh base to the top
18:39:12	-4.80317	-12.37187	2980	236	13.9	-4.8033328	-12.3710003	2971	top reached
18:39:52	-4.80317	-12.37182	2979	319	15.6	-4.8033328	-12.3710003	2972	top at 2979 , 13 m high
18:39:54	-4.80317	-12.37182	2979	323	15.1	-4.8033328	-12.3710003	2973	HD OFF
18:41:43	-4.80320	-12.37185	2979	356	14.1	-4.8033328	-12.3710003	2975	HD ON
18:43:24	-4.80327	-12.37182	2988	355	7.5	-4.8033328	-12.3710003	2975	HD OFF
18:47:27	-4.80322	-12.37183	2980	358	14.2	-4.8033328	-12.3710003	2975	looking for a place for sampling
18:51:24	-4.80313	-12.37187	2980	360	12.8	-4.8033328	-12.3710003	2974	HD ON
18:51:56	-4.80317	-12.37183	2981	357	11.5	-4.8033328	-12.3710003	2974	HD OFF
18:51:56	-4.80317	-12.37183	2981	357	11.5	-4.8033328	-12.3710003	2974	HD OFF
18:55:31	-4.80320	-12.37183	2981	360	11.2	-4.8033328	-12.3710003	2974	HD ON
18:55:37	-4.80322	-12.37182	2981	360	12.2	-4.8033328	-12.3710003	2973	HD OFF
18:57:22	-4.80320	-12.37187	2981	360	11.4	-4.8033328	-12.3710003	2976	found a parking spot in 11,2m height at Sisters Peak
18:59:48	-4.80318	-12.37185	2980	342	12.1	-4.8033328	-12.3710003	2972	HD ON
19:03:20	-4.80325	-12.37180	2981	9	11.6	-4.8033328	-12.3710003	2971	HD OFF
19:05:09	-4.80320	-12.37185	2981	351	15.2	-4.8033328	-12.3710003	2976	few smaller orifices at the top
19:05:47	-4.80322	-12.37187	2981	20	12.6	-4.8033328	-12.3710003	2972	park at underneath ledge with most intense venting above
19:07:53	-4.80320	-12.37187	2981	21	12.6	-4.8033328	-12.3710003	2974	next task:KIPS sampling and T measurement
19:08:20	-4.80320	-12.37187	2981	21	12.6	-4.8033328	-12.3710003	2972	HD ON
19:08:20	-4.80322	-12.37182	2981	21	12.6	-4.8033328	-12.3710003	2972	HD ON
19:09:02	-4.80320	-12.37183	2981	21	12.5	-4.8033328	-12.3710003	2973	HD OFF
19:09:03	-4.80320	-12.37183	2981	21	12.5	-4.8033328	-12.3710003	2973	HD OFF
19:10:50	-4.80320	-12.37185	2981	21	12.6	-4.8033328	-12.3710003	2973	HD ON
19:12:39	-4.80323	-12.37188	2981	21	12.7	-4.8033328	-12.3710003	2974	HD ON
19:13:07	-4.80320	-12.37185	2981	21	12.6	-4.8033328	-12.3710003	2974	still image
19:17:50	-4.80313	-12.37192	2981	--	--	-4.8033328	-12.3710003	2973	temperature "only" 200°C, move to a different orifice
19:20:10	-4.80317	-12.37187	2981	21	12.7	-4.8033328	-12.3710003	2972	still image
19:28:44	-4.80327	-12.37190	2980	21	12.7	-4.8033328	-12.3710003	2974	Tmax around 320°C, but nozzle could be a bit more in
19:30:37	-4.80318	-12.37188	2981	21	12.7	-4.8033328	-12.3710003	2976	KIPS ON
19:31:57	-4.80320	-12.37188	2980	21	12.8	-4.8033328	-12.3710003	2977	KIPS OFF
19:32:12	-4.80320	-12.37190	2980	21	13.1	-4.8033328	-12.3710003	2974	pump on and off, a little bocked with debris
19:34:36	-4.80320	-12.37187	2980	21	12.9	-4.8033328	-12.3710003	2976	around 300°C
19:37:06	-4.80318	-12.37185	2981	20	12.7	-4.8033328	-12.3710003	2973	filling A2 pump off
19:37:11	-4.80322	-12.37187	2981	21	12.7	-4.8033328	-12.3710003	2973	sample_2
19:42:49	-4.80327	-12.37182	2980	20	12.6	-4.8033328	-12.3710003	2970	still difficult to position the nozzle into the small orifice

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
19:46:13	-4.80322	-12.37190	2980	20	12.8	-4.8033328	-12.3710003	2968	KIPS ON
19:46:20	-4.80318	-12.37187	2980	20	12.9	-4.8033328	-12.3710003	2969	max 375°C
19:46:57	-4.80318	-12.37190	2980	20	13.3	-4.8033328	-12.3710003	2972	filling A2 once more
19:48:31	-4.80325	-12.37183	2980	20	13.4	-4.8033328	-12.3710003	2974	still image
19:49:52	-4.80322	-12.37183	2980	20	12.8	-4.8033328	-12.3710003	2974	KIPS OFF
19:50:18	-4.80323	-12.37193	2980	20	12.5	-4.8033328	-12.3710003	2976	KIPS ON
19:50:31	-4.80322	-12.37187	2980	20	12.8	-4.8033328	-12.3710003	2975	filling A1
19:50:33	-4.80322	-12.37187	2980	20	12.8	-4.8033328	-12.3710003	2975	sample_3
19:50:58	-4.80318	-12.37192	2980	20	12.7	-4.8033328	-12.3710003	2973	375°C still - excellent!
19:52:00	-4.80317	-12.37182	2980	20	13.3	-4.8033328	-12.3710003	2972	KIPS OFF
19:52:11	-4.80317	-12.37183	2980	20	12.7	-4.8033328	-12.3710003	2977	Dosierpumpe on
19:52:26	-4.80318	-12.37190	2980	20	12.6	-4.8033328	-12.3710003	2971	373°C still
19:53:32	-4.80317	-12.37180	2980	20	13.3	-4.8033328	-12.3710003	2973	360°C
19:53:46	-4.80322	-12.37180	2980	20	13.3	-4.8033328	-12.3710003	2975	close Dosierpumpe
19:54:09	-4.80323	-12.37180	2980	20	13.3	-4.8033328	-12.3710003	2972	373°C
19:54:33	-4.80323	-12.37183	2980	20	12.5	-4.8033328	-12.3710003	2975	KIPS ON
19:54:41	-4.80320	-12.37185	2980	20	12.5	-4.8033328	-12.3710003	2974	filling A3
19:56:28	-4.80318	-12.37185	2980	20	12.7	-4.8033328	-12.3710003	2971	KIPS OFF
19:56:32	-4.80315	-12.37187	2980	20	12.7	-4.8033328	-12.3710003	2971	KIPS ON
19:57:02	-4.80317	-12.37185	2980	20	13.4	-4.8033328	-12.3710003	2969	small blocking pump off and on, now it works
19:58:15	-4.80313	-12.37187	2980	20	13.4	-4.8033328	-12.3710003	2977	372°C still, very stable
20:00:38	-4.80318	-12.37188	2980	20	12.9	-4.8033328	-12.3710003	2977	KIPS OFF
20:00:40	-4.80318	-12.37188	2980	20	13.4	-4.8033328	-12.3710003	2977	sample_4
20:01:35	-4.80317	-12.37187	2980	20	13.2	-4.8033328	-12.3710003	2977	KIPS ON
20:01:41	-4.80317	-12.37185	2980	20	13.4	-4.8033328	-12.3710003	2977	filling B4
20:03:13	-4.80318	-12.37192	2980	20	13.2	-4.8033328	-12.3710003	2973	375°C
20:05:45	-4.80327	-12.37185	2980	20	13.3	-4.8033328	-12.3710003	2973	KIPS OFF
20:05:49	-4.80328	-12.37178	2980	21	13.3	-4.8033328	-12.3710003	2973	375°
20:05:54	-4.80328	-12.37178	2980	20	12.6	-4.8033328	-12.3710003	2973	sample_5
20:06:43	-4.80327	-12.37198	2980	20	13	-4.8033328	-12.3710003	2976	KIPS ON
20:07:12	-4.80320	-12.37188	2980	20	13.4	-4.8033328	-12.3710003	2968	filling B5
20:07:18	-4.80325	-12.37190	2980	20	13.3	-4.8033328	-12.3710003	2980	still 375°C
20:07:56	-4.80317	-12.37190	2980	20	13.3	-4.8033328	-12.3710003	2974	still image
20:08:46	-4.80317	-12.37190	2980	20	13.3	-4.8033328	-12.3710003	2976	still image
20:08:49	-4.80317	-12.37190	2980	20	13.3	-4.8033328	-12.3710003	2976	still image
20:09:00	-4.80322	-12.37188	2980	20	13.3	-4.8033328	-12.3710003	2976	still images of sampling spot
20:11:45	-4.80318	-12.37185	2980	20	13.4	-4.8033328	-12.3710003	2975	KIPS OFF
20:11:46	-4.80318	-12.37185	2980	20	13	-4.8033328	-12.3710003	2975	sample_6
20:12:56	-4.80325	-12.37187	2980	21	13.3	-4.8033328	-12.3710003	2979	KIPS ON
20:13:39	-4.80320	-12.37187	2980	20	13.4	-4.8033328	-12.3710003	2972	filling B6, temperature stable at 375°C
20:18:15	-4.80323	-12.37188	2980	20	13.3	-4.8033328	-12.3710003	2975	KIPS OFF
20:18:16	-4.80323	-12.37188	2980	20	13.3	-4.8033328	-12.3710003	2975	sample_7
20:18:30	-4.80320	-12.37183	2980	20	13.3	-4.8033328	-12.3710003	2974	KIPS finished for the day
20:22:03	-4.80325	-12.37185	2980	20	12.9	-4.8033328	-12.3710003	2973	stow away KIPS
20:24:24	-4.80315	-12.37182	2980	20	12.9	-4.8033328	-12.3710003	2978	grabing Ti major D2
20:38:12	-4.80313	-12.37190	2980	20	13.2	-4.8033328	-12.3710003	2978	sample_8
20:38:24	-4.80317	-12.37187	2980	20	13	-4.8033328	-12.3710003	2978	sampling D2 Ti major
20:38:41	-4.80317	-12.37188	2980	20	13	-4.8033328	-12.3710003	2965	still image
20:38:42	-4.80317	-12.37188	2980	20	13	-4.8033328	-12.3710003	2965	still image
20:40:15	-4.80317	-12.37188	2980	20	13.2	-4.8033328	-12.3710003	2971	finished sampling fluids
20:44:54	-4.80322	-12.37188	2979	349	14	-4.8033328	-12.3710003	2973	next task: collect rocks with young mussels at Golden Valley
20:47:09	-4.80295	-12.37152	2989	83	2.4	-4.8033328	-12.3710003	2973	
20:47:24	-4.80285	-12.37152	2987	83	3	-4.8033328	-12.3710003	2973	HD ON
20:47:41	-4.80285	-12.37152	2985	77	3.1	-4.8033328	-12.3710003	2972	Gorgonia
20:47:41	-4.80285	-12.37152	2985	77	3.1	-4.8033328	-12.3710003	2972	Gorgonia
20:48:50	-4.80280	-12.37135	2979	121	1.9	-4.8035002	-12.3710003	2973	mussels on shoulder of fault
20:49:28	-4.80283	-12.37128	2977	119	3.1	-4.8033328	-12.3710003	2970	Golden Valley reached?
20:50:44	-4.80278	-12.37127	2978	109	1.5	-4.8033328	-12.3710003	2974	marker no. 6
20:51:28	-4.80277	-12.37128	2977	171	2	-4.8033328	-12.3708334	2974	HD OFF
20:54:31	-4.80283	-12.37130	2975	168	3.9	-4.8033328	-12.3706675	2972	marker 6 is at Golden Valley
20:56:12	-4.80282	-12.37128	2976	149	3.6	-4.8033328	-12.3706675	2972	pillows covered with limpets
20:58:40	-4.80278	-12.37132	2980	44	1.6	-4.8033328	-12.3706675	2970	follow the trench/fault to NE (heading 43)
20:59:04	-4.80273	-12.37132	2981	44	0.5	-4.8033328	-12.3706675	2971	actually looking NE but flying N
21:04:33	-4.80260	-12.37128	2980	184	5.4	-4.8033328	-12.3706675	2972	northern edge of fault/trench
21:04:57	-4.80255	-12.37130	2980	184	4.7	-4.8033328	-12.3706675	2971	turning ROV and move back south into the trench towards GoldenValley
21:07:54	-4.80255	-12.37128	2982	184	3.5	-4.8033328	-12.3706675	2970	fault is 2,18m wide
21:08:13	-4.80257	-12.37130	2982	183	3.5	-4.8033328	-12.3706675	2966	HD ON
21:08:46	-4.80263	-12.37127	2981	184	3.8	-4.8033328	-12.3706675	2968	flying over opening of fault to the south
21:11:30	-4.80285	-12.37133	2981	170	2.1	-4.8033328	-12.3706675	2970	Golden Valley, walls coveredwith mussels
21:11:39	-4.80285	-12.37133	2981	166	3	-4.8033328	-12.3706675	2970	HD OFF
21:17:07	-4.80298	-12.37130	2987	9	2.6	-4.8033328	-12.3706675	2971	dense coverage with mussels on the walls
21:17:33	-4.80292	-12.37130	2987	13	2.4	-4.8033328	-12.3706675	2970	HD ON
21:20:03	-4.80292	-12.37132	2985	33	2.6	-4.8033328	-12.3706675	2971	HD OFF
21:20:52	-4.80287	-12.37125	2986	33	1.3	-4.8033328	-12.3706675	2971	HD ON
21:23:04	-4.80290	-12.37133	2986	33	1.3	-4.8033328	-12.3706675	2973	HD OFF
21:26:09	-4.80295	-12.37135	2986	33	1.4	-4.8033328	-12.3706675	2975	trying to collect a rock with small mussels
21:31:22	-4.80290	-12.37130	2987	35	0.7	-4.8033328	-12.3706675	2980	selected piece is too big to grab with Orion
21:34:27	-4.80290	-12.37137	2987	35	0.7	-4.8033328	-12.3706675	2973	big rock piece pushed on to the proch
21:34:31	-4.80290	-12.37137	2987	35	0.6	-4.8033328	-12.3706675	2973	sample_9
21:40:35	-4.80288	-12.37135	2987	35	0.7	-4.8033328	-12.3706675	2970	taking a mussel net
21:46:36	-4.80290	-12.37135	2987	37	0.5	-4.8033328	-12.3706675	2979	HD ON
21:48:38	-4.80287	-12.37135	2987	34	0.6	-4.8033328	-12.3706675	2975	HD OFF
21:48:59	-4.80283	-12.37135	2987	34	0.6	-4.8033328	-12.3706675	2973	HD of mussel scooping
21:52:21	-4.80288	-12.37130	2987	34	0.6	-4.8033328	-12.3706675	2974	sample_10
21:52:46	-4.80290	-12.37133	2987	34	0.6	-4.8033328	-12.3706675	2974	a few mussels in net as this sample
21:54:25	-4.80290	-12.37137	2987	34	0.6	-4.8033328	-12.3706675	2974	mussel net stowed into sample drawer

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
21:56:20	-4.80287	-12.37135	2987	33	0.6	-4.8033328	-12.3706675	2978	still image
21:56:21	-4.80293	-12.37132	2987	33	0.6	-4.8033328	-12.3706675	2978	still image
21:56:34	-4.80295	-12.37132	2987	33	0.6	-4.8033328	-12.3706675	2982	still images from little smoker
22:01:55	-4.80283	-12.37138	2987	34	0.6	-4.8033328	-12.3706675	2972	a number of still images of small smoker
22:04:50	-4.80292	-12.37133	2984	36	3.2	-4.8033328	-12.3706675	2970	OFF THE BOTTOM
23:47:55	0.00000	0.00000	17	--	--	-4.8033328	-12.3704996	2969	ON DECK

Cruise: MAR SOUTH V
Date: 26.04.2009
Station: M78-2_312ROV
Targets: Nibelungen

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
15:15:23	0.00000	0.00000	0	--	--	-8.2978334	-13.5085001	0	IN THE WATER
16:04:35	-8.29828	-13.50772	2000	286	36	-8.298667	-13.507	2937	2000 m ROV descending ok
16:19:35	-8.29805	-13.50735	2499	332	36	-8.298667	-13.507	2930	2500 m ROV descending ok
16:31:32	-8.29817	-13.50737	2905	251	20.4	-8.298667	-13.507	2928	AT THE BOTTOM
16:31:32	-8.29817	-13.50737	2905	251	20.4	-8.298667	-13.507	2928	
16:31:32	-8.29817	-13.50737	2905	251	20.4	-8.298667	-13.507	2928	Rimicaris, swarms
16:32:53	-8.29813	-13.50740	2913	349	13	-8.298667	-13.507	2949	pillow lava, > 50% sediment
16:34:18	-8.29818	-13.50747	2908	267	13.3	-8.298667	-13.507	2948	turning west
16:35:19	-8.29815	-13.50755	2907	304	7.9	-8.298667	-13.507	2942	dead chimneys
16:35:30	-8.29812	-13.50753	2910	306	5.9	-8.298667	-13.507	2944	HD ON
16:36:51	-8.29808	-13.50753	2910	250	5.5	-8.298667	-13.507	2938	HD OFF
16:37:08	-8.29807	-13.50757	2910	244	5.4	-8.298667	-13.507	2949	still image
16:38:23	-8.29808	-13.50755	2910	216	3.9	-8.298667	-13.507	2947	still image
16:40:46	-8.29808	-13.50758	2909	238	4.6	-8.2988329	-13.507	2934	in front of dead chimneys
16:42:14	-8.29817	-13.50760	2911	351	5.1	-8.298667	-13.507	2944	preparing to sample
16:44:38	-8.29803	-13.50757	2912	4	1.4	-8.298667	-13.507	2950	HD ON
16:44:59	-8.29817	-13.50750	2912	4	1.5	-8.298667	-13.507	2942	HD OFF
16:45:11	-8.29813	-13.50753	2912	4	1.5	-8.298667	-13.507	2945	still image
16:48:17	-8.29807	-13.50753	2912	353	1.6	-8.298667	-13.507	2940	drawer open
16:49:05	-8.29817	-13.50753	2912	353	1.6	-8.298667	-13.507	2939	opening sample box
16:50:15	-8.29813	-13.50753	2912	354	1.6	-8.298667	-13.507	2948	**sample 312 ROV-1**
16:50:58	-8.29813	-13.50755	2912	354	1.6	-8.298667	-13.507	2939	chimney beneath grey box
16:53:23	-8.29810	-13.50753	2912	354	1.7	-8.298667	-13.507	2947	box open
16:55:47	-8.29810	-13.50753	2912	354	1.7	-8.298667	-13.507	2942	taking second chimney sample
17:09:26	-8.29812	-13.50760	2912	354	1.7	-8.298667	-13.507	2936	pieces of chimney into box
17:42:11	-8.29805	-13.50753	2912	354	1.5	-8.298667	-13.507	2945	HD ON
17:44:56	-8.29815	-13.50760	2912	355	1.5	-8.298667	-13.507	2945	HD OFF
17:47:51	-8.29808	-13.50758	2912	354	1.4	-8.298667	-13.507	2945	box closed, drawer in
17:48:11	-8.29808	-13.50755	2912	355	1.4	-8.298667	-13.507	2944	moving on to Drachenschlund
17:53:54	-8.29777	-13.50752	2897	54	7.7	-8.298667	-13.507	2935	smoke
17:55:05	-8.29763	-13.50743	2900	303	13	-8.298667	-13.507	2946	Marker 9
17:56:41	-8.29773	-13.50737	2904	272	4.9	-8.298667	-13.507	2928	HD ON
17:58:47	-8.29772	-13.50753	2911	236	0.6	-8.298667	-13.507	2940	still image
17:59:26	-8.29775	-13.50748	2911	238	0.9	-8.298667	-13.507	2948	landed at drachenschlund
18:01:05	-8.29773	-13.50748	2911	273	1.6	-8.298667	-13.507	2932	HD OFF
18:34:19	-8.29772	-13.50752	2902	285	6.7	-8.298667	-13.507	2926	cable to temperature sensor burnt in vent fluid
18:35:00	-8.29773	-13.50753	2894	227	11.5	-8.298667	-13.507	2929	max temperature was 425 °C
18:36:57	-8.29778	-13.50763	2876	69	17.5	-8.298667	-13.507	2927	temperatures around 392 - 405 °C after cable was
19:47:43	-8.29760	-13.50825	2801	260	30.5	-8.2978334	-13.5065002	2929	ROV general power failure due to overheating of m
20:08:28	-8.29752	-13.50822	2789	260	30.5	-8.2978334	-13.5065002	2940	dive terminated. power supply does not cool down.
20:56:03	-8.29705	-13.50745	1583	305	30.5	-8.297833	-13.5065	2935	OFF THE BOTTOM
21:48:58	-8.29708	-13.50730	11	--	--	-8.298	-13.506333	2942	ON DECK

Cruise: MAR SOUTH V
Date: 27.04.2009
Station: M78-2_314ROV
Targets: Nibelungen

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
09:58:46	0.00000	0.00000	0	--	--	-8.297	-13.508667	2886	IN THE WATER
11:03:30	-8.29797	-13.50672	2645	330	30.5	-8.2974997	-13.5063334	2942	ROV descending without problems. Cable to temperature sensor repaired and working fine
11:06:07	-8.29788	-13.50692	2751	347	30.5	-8.2976665	-13.5061674	2948	2750 m descending ok
11:10:29	-8.29777	-13.50703	2918	347	18.8	-8.2976665	-13.5061674	2942	AT THE BOTTOM
11:11:25	-8.29775	-13.50702	2927	346	13.8	-8.2974997	-13.5061674	2930	landed at bottom, E of entrance to Drachenschlund
11:13:11	-8.29792	-13.50693	2927	297	13	-8.2976665	-13.5063334	2943	cameras white balance set
11:18:01	-8.29768	-13.50722	2919	328	2	-8.2974997	-13.5061674	2946	flying uphill, boulders, rock outcrops, sandy surface of the sediment
11:18:42	-8.29767	-13.50725	2916	326	2.1	-8.2976665	-13.5063334	2948	FeOOH fragments from gravel to rock size, steep slope
11:20:45	-8.29775	-13.50737	2907	212	5.8	-8.2976665	-13.5063334	2948	Marker found
11:22:59	-8.29773	-13.50733	2905	273	8.5	-8.2974997	-13.5061674	2924	HD ON
11:26:12	-8.29777	-13.50747	2908	276	0.3	-8.2976665	-13.5061674	2955	still image
11:27:27	-8.29775	-13.50750	2909	274	1	-8.2976665	-13.5063334	2951	still image
11:27:31	-8.29775	-13.50750	2909	274	0.9	-8.2976665	-13.5063334	2951	still image
11:28:16	-8.29780	-13.50750	2909	274	0.8	-8.2974997	-13.5061674	2940	nice still images of the vent, clear sight, w/ fish
11:28:49	-8.29778	-13.50752	2909	274	0.8	-8.2976665	-13.5061674	2928	HD OFF
11:28:54	-8.29778	-13.50750	2909	274	0.8	-8.2974997	-13.5061674	2936	HD ON
11:32:56	-8.29777	-13.50747	2909	272	0.7	-8.2974997	-13.5061674	2928	HD OFF
11:34:19	-8.29783	-13.50745	2909	273	0.7	-8.2974997	-13.5061674	2946	HD ON
11:35:16	-8.29768	-13.50747	2909	273	0.7	-8.2974997	-13.5061674	2934	HD OFF
11:36:11	-8.29778	-13.50745	2910	272	0.7	-8.2976665	-13.5061674	2945	HD ON
11:39:33	-8.29780	-13.50753	2910	265	0.5	-8.2976665	-13.5061674	2932	still image
11:39:45	-8.29775	-13.50747	2910	265	0.5	-8.2976665	-13.5061674	2934	HD ON
11:42:07	-8.29782	-13.50750	2910	267	0.5	-8.2974997	-13.5061674	2946	we try to bring the ROV closer to the orifice, step by step
11:42:17	-8.29777	-13.50750	2910	267	0.5	-8.2976665	-13.5063334	2953	HD OFF
11:43:40	-8.29775	-13.50752	2910	270	0.5	-8.2974997	-13.5063334	2948	HD ON
11:46:48	-8.29780	-13.50743	2910	270	0.5	-8.2974997	-13.5061674	2937	KIPS ON
11:47:22	-8.29778	-13.50745	2910	270	0.5	-8.2976665	-13.5061674	2950	Filling bottle A1, 368 °C
11:47:22	-8.29778	-13.50745	2910	270	0.5	-8.2976665	-13.5061674	2950	**sample 314 ROV-1 (KIPS- A1)**
11:48:59	-8.29775	-13.50745	2910	270	0.5	-8.2976665	-13.5063334	2947	HD OFF
11:49:51	-8.29772	-13.50747	2910	270	0.5	-8.2974997	-13.5063334	2942	in situ fixation on for 1 minute
11:51:47	-8.29777	-13.50753	2910	270	0.5	-8.2976665	-13.5063334	2957	KIPS OFF
11:51:55	-8.29777	-13.50753	2910	270	0.5	-8.2976665	-13.5063334	2946	KIPS ON
11:55:47	-8.29777	-13.50750	2910	270	0.5	-8.2974997	-13.5061674	2944	HD ON
11:58:19	-8.29780	-13.50745	2910	270	0.5	-8.2976665	-13.5063334	2945	Filling A2
11:58:19	-8.29780	-13.50745	2910	270	0.5	-8.2976665	-13.5063334	2945	**sample 314 ROV-2 (KIPS- A2)**
11:58:33	-8.29778	-13.50748	2910	270	0.5	-8.2976665	-13.5063334	2954	filling A3
11:58:33	-8.29778	-13.50748	2910	270	0.5	-8.2976665	-13.5063334	2954	**sample 314 ROV-3 (KIPS- A3)**
11:59:03	-8.29775	-13.50752	2910	270	0.5	-8.2976665	-13.5063334	2943	HD OFF
12:05:29	-8.29778	-13.50745	2910	270	0.5	-8.2974997	-13.5063334	2947	Filling B4 to B6
12:05:29	-8.29778	-13.50745	2910	270	0.5	-8.2974997	-13.5063334	2947	**sample 314 ROV-4 (KIPS- B4)**
12:05:29	-8.29778	-13.50745	2910	270	0.5	-8.2974997	-13.5063334	2947	**sample 314 ROV-5 (KIPS- B5)**
12:05:29	-8.29778	-13.50745	2910	270	0.5	-8.2974997	-13.5063334	2947	**sample 314 ROV-6 (KIPS- B6)**
12:06:51	-8.29777	-13.50750	2910	270	0.5	-8.2976665	-13.5063334	2941	still image
12:24:37	-8.29777	-13.50743	2910	269	0.5	-8.2976665	-13.5061674	2944	clear fluid from KIPS outlet
12:25:29	-8.29778	-13.50745	2910	269	0.5	-8.2976665	-13.5063334	2938	bring the nozzle higher into the mixing zone with ambient seawater so that sampling for MIrjam is at 100 °C
12:27:20	-8.29777	-13.50748	2910	269	0.5	-8.2974997	-13.5061674	2950	HD ON
12:27:44	-8.29777	-13.50748	2910	--	--	-8.2974997	-13.5061674	2949	still image
12:28:46	-8.29778	-13.50747	2910	269	0.5	-8.2974997	-13.5061674	2934	still images KIPS outlet w/ smoke, orifice w/ nozzle at higher position
12:29:20	-8.29778	-13.50743	2910	269	0.5	-8.2976665	-13.5063334	2950	sampling temperature for bottles C7-9 is 90-120 °C
12:29:20	-8.29778	-13.50743	2910	269	0.5	-8.2976665	-13.5063334	2950	**sample 314 ROV-7 (KIPS- C7)**
12:29:20	-8.29778	-13.50743	2910	269	0.5	-8.2976665	-13.5063334	2950	**sample 314 ROV-8 (KIPS- C8)**
12:29:20	-8.29778	-13.50743	2910	269	0.5	-8.2976665	-13.5063334	2950	**sample 314 ROV-9 (KIPS- C9)**
12:30:26	-8.29780	-13.50742	2910	269	0.5	-8.2974997	-13.5063334	2944	HD ON
12:30:28	-8.29780	-13.50742	2910	269	0.5	-8.2974997	-13.5061674	2944	HD OFF
12:30:43	-8.29782	-13.50745	2910	269	0.5	-8.2976665	-13.5063334	2939	HD from sampling the smoke
12:44:42	-8.29778	-13.50748	2910	269	0.5	-8.2976665	-13.5061674	2942	pump off
12:46:07	-8.29777	-13.50750	2910	269	0.5	-8.2976665	-13.5063334	2938	KIPS sampling finished
12:49:39	-8.29773	-13.50747	2910	269	0.5	-8.2974997	-13.5061674	2959	Scanning of tzhe orifice for maximum fluid temperature resultes in 370 °C max
12:53:50	-8.29780	-13.50752	2909	286	0.9	-8.2974997	-13.5061674	2939	off bottom
12:54:40	-8.29772	-13.50748	2900	277	6.5	-8.2976665	-13.5063334	2951	flying along steep edge to the north
12:55:37	-8.29763	-13.50743	2900	334	3.9	-8.2974997	-13.5063334	2952	pillow lava, < 50% sediment
12:55:46	-8.29767	-13.50747	2899	359	3.5	-8.2976665	-13.5063334	2949	inactive chimney
12:56:29	-8.29763	-13.50752	2897	349	5.3	-8.2976665	-13.5063334	2937	HD ON
12:59:01	-8.29757	-13.50767	2893	308	7	-8.2974997	-13.5061674	2937	inactive chimney, broken in the middle
12:59:03	-8.29757	-13.50767	2893	309	7.5	-8.2976665	-13.5061674	2937	HD OFF
12:59:45	-8.29755	-13.50752	2893	291	9.4	-8.2976665	-13.5061674	2935	eventually pillows in the back; visiible in the HD
13:00:25	-8.29748	-13.50750	2897	335	5.3	-8.2976665	-13.5061674	2950	flying to North along the ridge
13:00:53	-8.29753	-13.50755	2899	357	2.8	-8.2976665	-13.5063334	2954	probably basaltic
13:02:16	-8.29743	-13.50762	2895	355	2.5	-8.2974997	-13.5063334	2953	looks basaltic, but not clear; full of talus
13:02:50	-8.29738	-13.50770	2895	359	0.9	-8.2974997	-13.5063334	2951	attempt to get a sample

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:07:25	-8.29737	-13.50763	2897	292	1.3	-8.2974997	-13.5061674	2933	two samples from the same spot; one sample no
13:07:44	-8.29730	-13.50767	2897	293	1.3	-8.2976665	-13.5061674	2935	**sample 314 ROV-10**
13:09:23	-8.29740	-13.50762	2897	292	1.2	-8.2976665	-13.5063334	2917	ROV
13:09:23	-8.29740	-13.50762	2897	292	1.2	-8.2976665	-13.5063334	2917	
13:09:50	-8.29738	-13.50762	2897	292	1.3	-8.2976665	-13.5063334	2939	stone one into the drwawer beside the box
13:10:27	-8.29738	-13.50753	2897	--	--	-8.2976665	-13.5063334	2944	stone 2 at the same plcase
13:10:30	-8.29738	-13.50753	2897	292	1.3	-8.2976665	-13.5063334	2944	sample STOP
13:11:21	-8.29737	-13.50758	2896	332	2.9	-8.2974997	-13.5063334	2945	continuing the tour to North along the flank of the rift
13:12:29	-8.29728	-13.50762	2897	1	1.3	-8.2974997	-13.5061674	2952	talus, boulder size
13:13:02	-8.29725	-13.50762	2897	1	1.4	-8.2976665	-13.5061674	2931	talus blocks just passed probably m-sized pillows
13:13:33	-8.29718	-13.50760	2897	341	2.8	-8.2974997	-13.5061674	2941	talus, pebble size
13:15:07	-8.29710	-13.50762	2897	323	5.7	-8.2974997	-13.5061674	2950	steep wall made of pebble-sized talus
13:17:18	-8.29698	-13.50758	2901	345	7.2	-8.2974997	-13.5061674	2943	talus obviusly fixed by some matrix
13:18:19	-8.29682	-13.50755	2899	318	5.9	-8.2974997	-13.5061674	2952	now less dense talus wall, much more sediments
13:19:50	-8.29673	-13.50767	2889	335	6.4	-8.2976665	-13.5063334	2937	still image
13:20:23	-8.29667	-13.50770	2886	327	6.9	-8.2976665	-13.5063334	2945	HD ON
13:20:43	-8.29667	-13.50775	2884	327	8.2	-8.2976665	-13.5063334	2945	change to massive pillow
13:22:05	-8.29660	-13.50778	2876	328	5.9	-8.2974997	-13.5061674	2939	top of the pillow mound
13:22:18	-8.29663	-13.50780	2877	332	5.9	-8.2974997	-13.5061674	2935	pillow lava, > 50% sediment
13:22:24	-8.29663	-13.50780	2876	345	5.9	-8.2976665	-13.5061674	2935	HD OFF
13:25:13	-8.29662	-13.50753	2903	89	2.6	-8.2974997	-13.5061674	2938	pillow lava, > 50% sediment
13:30:44	-8.29665	-13.50697	2938	90	3.1	-8.2976665	-13.5061674	2937	we moved last minutes to the West, down into the valley again
13:31:37	-8.29663	-13.50682	2944	91	2.2	-8.2974997	-13.5061674	2927	probably talus of pillow basalt, highly mixed with sedim.
13:32:30	-8.29658	-13.50670	2948	84	2.3	-8.2974997	-13.5061674	2932	big pillows as talus
13:33:29	-8.29658	-13.50662	2951	83	1.6	-8.2974997	-13.5061674	2942	talus, boulder size
13:34:11	-8.29658	-13.50650	2952	91	3.4	-8.2974997	-13.5061674	2949	blocks of pillows in between; lot of sediment
13:35:47	-8.29653	-13.50637	2952	91	3.3	-8.2974997	-13.5059996	2941	end of map reached
13:36:10	-8.29653	-13.50637	2950	91	2.2	-8.2974997	-13.5059996	2950	climbing a rift probably made of talus from pillow basalt
13:36:39	-8.29650	-13.50628	2947	90	4	-8.2974997	-13.5059996	2934	broken m-sized pillows visible
13:37:58	-8.29650	-13.50622	2941	90	3.2	-8.2973328	-13.5059996	2934	still talus of pillow bas; lot of sediment in between
13:37:59	-8.29650	-13.50622	2941	90	3.4	-8.2973328	-13.5059996	2934	
13:39:50	-8.29647	-13.50610	2931	76	6.9	-8.2973328	-13.5058327	2920	top of the hill: pillow basalt outcrop; nice tubes (still cam)
13:40:09	-8.29647	-13.50612	2930	79	8	-8.2973328	-13.5058327	2937	still image
13:41:20	-8.29642	-13.50608	2929	95	1.5	-8.2973328	-13.5056667	2914	pillow lava, > 50% sediment
13:41:51	-8.29648	-13.50603	2926	94	3.9	-8.2971668	-13.5056667	2921	pillow to lobate flow
13:43:11	-8.29647	-13.50587	2924	95	2.4	-8.2971668	-13.5054998	2910	climbing up a wall of pillow bas
13:43:22	-8.29643	-13.50588	2923	95	3.1	-8.2971668	-13.5054998	2910	still image
13:44:00	-8.29640	-13.50587	2921	95	3.6	-8.2971668	-13.5054998	2912	lobate flow, > 50 % sediment
13:44:18	-8.29640	-13.50583	2921	95	2.2	-8.2971668	-13.5054998	2908	some kind of plateau
13:48:47	-8.29638	-13.50538	2915	88	2.7	-8.2971668	-13.5054998	2908	new map made in the previous night
13:49:05	-8.29642	-13.50537	2915	84	2.7	-8.2971668	-13.5053329	2906	heading to the hill in eastwards
13:49:12	-8.29635	-13.50535	2914	80	3	-8.2971668	-13.5053329	2905	still image
13:49:36	-8.29642	-13.50532	2912	89	3.8	-8.2971668	-13.5053329	2880	nice pillows (still cam); high amount of sediments
13:50:07	-8.29637	-13.50527	2910	94	4.1	-8.2971668	-13.5053329	2930	steep wall of pillow bas in front of us
13:52:18	-8.29642	-13.50523	2900	95	1.3	-8.2973328	-13.505167	2888	reaching some kind of plateau; 90% sediment
13:53:31	-8.29632	-13.50508	2891	88	4	-8.2973328	-13.5050001	2884	lots of talus of pillow basalt, many sediment
13:53:47	-8.29625	-13.50505	2888	88	5	-8.2973328	-13.5050001	2882	climbing further to East
13:54:53	-8.29622	-13.50497	2881	90	4.3	-8.2974997	-13.5048332	2869	pillow lava, > 50% sediment
13:55:47	-8.29620	-13.50483	2881	90	0.3	-8.2974997	-13.5048332	2872	reaching a plateau; 100% sediment
13:56:38	-8.29620	-13.50475	2880	102	0.9	-8.2974997	-13.5046673	2874	Holothurian
13:57:42	-8.29617	-13.50473	2879	102	1.3	-8.2976665	-13.5046673	2865	HD ON
13:58:15	-8.29620	-13.50475	2879	102	1.3	-8.2976665	-13.5045004	2858	HD OFF
14:01:06	-8.29617	-13.50470	2879	100	1.8	-8.2978334	-13.5043325	2857	HD ON
14:01:17	-8.29617	-13.50470	2879	104	2.1	-8.2978334	-13.5043325	2868	Holothurian
14:01:20	-8.29617	-13.50470	2879	105	2	-8.2978334	-13.5043325	2868	HD OFF
14:03:47	-8.29615	-13.50463	2871	103	3.7	-8.2980003	-13.5039997	2872	climbing a hill on the way to West; talus of pillow bas
14:04:15	-8.29618	-13.50465	2869	100	5.3	-8.2980003	-13.5039997	2865	now the related outcrop of pillow bas
14:05:05	-8.29617	-13.50463	2865	105	8.6	-8.2980003	-13.5039997	2879	broken tubes, broken pillows in the outcrop
14:05:27	-8.29617	-13.50463	2863	106	11.9	-8.2980003	-13.5038328	2868	steep wall no sediments
14:08:28	-8.29618	-13.50448	2848	94	20.7	-8.2980003	-13.5038328	2866	still wall of pillow bas
14:10:58	-8.29613	-13.50452	2834	74	8.2	-8.2980003	-13.5038328	2872	still climbing in steep pillow bas wall
14:11:00	-8.29613	-13.50452	2834	73	8.3	-8.2980003	-13.5038328	2872	HD ON
14:12:03	-8.29617	-13.50453	2831	74	17.9	-8.2980003	-13.5038328	2870	something strange in the gaps between pillows
14:12:59	-8.29620	-13.50452	2832	85	17.1	-8.2980003	-13.5038328	2866	tannatosynosis
14:13:23	-8.29622	-13.50448	2831	84	17.1	-8.2980003	-13.5038328	2876	HD OFF
14:13:56	-8.29620	-13.50443	2831	85	17.1	-8.2980003	-13.5038328	2869	place where mussel shells and other things where sedimented together
14:15:20	-8.29618	-13.50433	2830	65	1.6	-8.2980003	-13.5038328	2871	large pillows with animal
14:15:31	-8.29618	-13.50442	2830	47	1.1	-8.2980003	-13.5038328	2869	HD ON
14:17:13	-8.29613	-13.50445	2830	17	0.8	-8.2980003	-13.5038328	2871	still image
14:17:35	-8.29618	-13.50447	2830	16	0.8	-8.2980003	-13.5038328	2870	HD OFF
14:17:39	-8.29618	-13.50447	2830	42	1.3	-8.2980003	-13.5038328	2870	anemone
14:18:05	-8.29613	-13.50440	2829	76	0.5	-8.2980003	-13.5038328	2868	Heading to the top of the hill in the W
14:18:14	-8.29617	-13.50438	2830	76	0.8	-8.2980003	-13.5038328	2868	pillow lava, > 50% sediment
14:19:05	-8.29617	-13.50430	2831	88	0.8	-8.2980003	-13.5038328	2866	pillow lava, > 50% sediment
14:20:26	-8.29610	-13.50418	2832	83	1	-8.2980003	-13.5038328	2874	sediment with ripple marks
14:21:06	-8.29603	-13.50417	2833	86	1.7	-8.2980003	-13.5038328	2875	"schill", carbonate shells

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
14:21:26	-8.29600	-13.50417	2833	82	1.7	-8.2980003	-13.5038328	2871	open pillow
14:21:28	-8.29600	-13.50417	2833	83	1.7	-8.2980003	-13.5038328	2871	still image
14:23:01	-8.29607	-13.50402	2831	92	0.6	-8.2980003	-13.5038328	2874	another pillow with mound
14:23:03	-8.29607	-13.50402	2831	91	0.6	-8.2980003	-13.5038328	2874	still image
14:24:16	-8.29600	-13.50382	2830	88	1	-8.2980003	-13.5038328	2872	HD ON
14:24:29	-8.29605	-13.50393	2829	79	1.2	-8.2980003	-13.5038328	2868	Protuberances
14:25:01	-8.29605	-13.50390	2829	105	1.4	-8.2980003	-13.5038328	2869	lobate flow, > 50 % sediment
14:25:06	-8.29605	-13.50390	2829	105	1	-8.2980003	-13.5038328	2869	HD OFF
14:25:19	-8.29605	-13.50387	2828	106	1.5	-8.2980003	-13.5038328	2869	HD ON
14:25:29	-8.29605	-13.50387	2828	107	1.5	-8.2980003	-13.5038328	2871	HD OFF
14:25:47	-8.29605	-13.50387	2829	--	--	-8.2980003	-13.5038328	2870	mixture of pillow and alien
14:25:51	-8.29605	-13.50387	2829	115	1.1	-8.2980003	-13.5038328	2870	HD OFF
14:26:14	-8.29602	-13.50387	2829	124	0.7	-8.2980003	-13.5038328	2873	still image
14:27:54	-8.29605	-13.50378	2827	97	0.6	-8.2980003	-13.5038328	2865	large tube with flow structure
14:28:22	-8.29607	-13.50370	2827	106	0.5	-8.2980003	-13.5038328	2873	open pillow with plant
14:28:59	-8.29598	-13.50378	2827	117	1	-8.2980003	-13.5038328	2869	still image
14:30:58	-8.29605	-13.50357	2826	117	1.3	-8.2980003	-13.5038328	2878	top of the hill
14:31:02	-8.29605	-13.50357	2826	117	1.4	-8.2980003	-13.5038328	2878	pillow lava, > 50% sediment
14:31:48	-8.29608	-13.50350	2825	235	3.5	-8.2980003	-13.5038328	2871	passing a small graben; on the other side talus of what?
14:31:58	-8.29608	-13.50352	2826	235	3.1	-8.2980003	-13.5038328	2871	HD ON
14:32:12	-8.29612	-13.50353	2826	235	2.9	-8.2980003	-13.5038328	2870	sharp graben structure
14:32:54	-8.29608	-13.50360	2826	177	2.6	-8.2980003	-13.5038328	2868	graben strikes 240°
14:33:55	-8.29608	-13.50350	2824	67	4.2	-8.2980003	-13.5038328	2868	Crab
14:34:22	-8.29600	-13.50345	2822	51	5.9	-8.2980003	-13.5038328	2871	Looking to the graben from the other side
14:38:09	-8.29583	-13.50337	2831	69	4.3	-8.2980003	-13.5038328	2868	following the graben to E to reach the valley est of the hill
14:43:46	-8.29558	-13.50305	2857	113	6.9	-8.2980003	-13.5038328	2868	leaving the ridge heading to the valley east of the ridge
14:47:59	-8.29580	-13.50253	2885	120	7.7	-8.2978334	-13.5036669	2855	wall below seems to ocnstist of talus of pillow basalt
14:53:20	-8.29558	-13.50265	2869	115	19.3	-8.2974997	-13.5030003	2905	problem with the cable; moving up a little bit to look for cable
15:11:50	-8.29647	-13.50283	2827	183	18.7	-8.2973328	-13.5026674	2900	problems solved; heading to South
15:25:33	-8.29695	-13.50223	2913	159	11	-8.2973328	-13.5026674	2898	facing the flank of the ridge: probably pillows, highly sedimented
15:26:08	-8.29697	-13.50225	2913	159	11	-8.2973328	-13.5026674	2898	many problems with the ROV in this valley, probably due to strong current forces
15:27:24	-8.29685	-13.50208	2922	160	7.6	-8.2973328	-13.5026674	2921	100% sediments in the valley
15:29:07	-8.29698	-13.50185	2927	200	14.8	-8.2973328	-13.5026674	2898	outcrop looks very disrupted; not clear wether disrupted pillows or condensed talus
15:34:36	-8.29723	-13.50168	2931	152	11	-8.2973328	-13.5024996	2895	heading to SE, pillows in the wall
15:37:01	-8.29737	-13.50175	2933	196	4.8	-8.2973328	-13.5023327	2895	heading to W to the flank; still pillow bas; highly sedimented
15:39:04	-8.29748	-13.50167	2934	248	6.4	-8.2973328	-13.5019999	2903	lobate flow, > 50 % sediment
15:41:00	-8.29780	-13.50195	2932	221	0.9	-8.2973328	-13.501833	2912	Holothurian
15:41:11	-8.29773	-13.50198	2932	208	0.6	-8.2973328	-13.501833	2903	HD ON
15:41:27	-8.29780	-13.50198	2932	207	0.6	-8.2973328	-13.501833	2929	still image
15:41:55	-8.29778	-13.50190	2932	209	0.8	-8.2973328	-13.501833	2914	HD OFF
15:42:35	-8.29778	-13.50200	2932	229	1.3	-8.2973328	-13.501833	2919	still image
15:45:28	-8.29800	-13.50187	2929	261	7.6	-8.2973328	-13.501833	2920	some minutes ago: two tubes dipping in the same direction parallel to the slope of the hill
15:45:49	-8.29813	-13.50202	2929	239	6.3	-8.2973328	-13.501833	2905	heading to the
15:46:38	-8.29818	-13.50208	2930	238	4.4	-8.2973328	-13.501833	2923	heading to SW to reach a zone which could represent a fault connection to Drachenschl.
15:50:13	-8.29843	-13.50223	2936	274	3.5	-8.2973328	-13.501833	2923	still lava tubes and pillows; highly sedim.
15:51:38	-8.29852	-13.50245	2942	274	1.2	-8.2973328	-13.501833	2923	some kind of vally, full with sediments
15:54:47	-8.29858	-13.50280	2946	242	1.5	-8.2973328	-13.501833	2922	sediment structures with mussel shells like dunes
15:54:49	-8.29858	-13.50280	2946	240	1.4	-8.2973328	-13.501833	2922	HD ON
15:54:53	-8.29860	-13.50282	2947	250	1.2	-8.2973328	-13.501833	2922	HD OFF
15:56:16	-8.29852	-13.50292	2946	301	0.9	-8.2973328	-13.501833	2923	still image
15:56:46	-8.29858	-13.50297	2946	295	0.9	-8.2973328	-13.501833	2922	still image of an dune-like sedim ridge
15:57:57	-8.29857	-13.50300	2944	300	1.9	-8.2973328	-13.501833	2925	Holothurian
15:58:00	-8.29857	-13.50300	2944	--	--	-8.2973328	-13.501833	2925	still image
15:58:18	-8.29848	-13.50303	2944	304	1.5	-8.2973328	-13.501833	2921	sediment
15:59:22	-8.29847	-13.50310	2943	359	0.6	-8.2973328	-13.501833	2924	Heading to North in the direction of the pillow mound
16:00:22	-8.29840	-13.50310	2940	358	2.5	-8.2973328	-13.501833	2922	sediment
16:00:42	-8.29843	-13.50315	2941	4	0.9	-8.2973328	-13.501833	2912	sediment with ripple marks
16:01:08	-8.29838	-13.50320	2940	3	0.9	-8.2973328	-13.501833	2891	lots of schill
16:02:36	-8.29823	-13.50318	2937	358	2.2	-8.2973328	-13.501833	2919	first boulders visible
16:03:54	-8.29817	-13.50322	2934	21	1.5	-8.2973328	-13.501833	2923	pillow boulds probably fallen from above; should be a steep relief
16:05:38	-8.29805	-13.50322	2930	359	2.8	-8.2973328	-13.501833	2899	talus: cracked pillow basalt
16:06:22	-8.29805	-13.50320	2928	360	2.3	-8.2973328	-13.501833	2914	approaching a flank made of broken pillows
16:06:32	-8.29802	-13.50320	2927	360	2.6	-8.2973328	-13.501833	2919	talus, boulder size
16:07:52	-8.29792	-13.50320	2921	360	2.6	-8.2973328	-13.501833	2922	talus, cobble size
16:09:19	-8.29793	-13.50323	2916	360	2.6	-8.2973328	-13.501833	2901	slope with sediments and talus of pillow basalt
16:09:44	-8.29780	-13.50313	2915	0	4	-8.2973328	-13.501833	2921	OFF THE BOTTOM
18:39:48	-8.29553	-13.50147	14	--	--	-8.297833	-13.5025	2932	ON DECK
									sample of sulfide talus found on ROV porch = assigned 314ROV-11

Cruise: MAR SOUTH V
Date: 29.04.2009
Station: M78-2_319ROV
Targets: Lilliput

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
11:26:24	-9.54727	-13.21135	677	42	0.0	-9.5474997	-13.2101669	1487	IN THE WATER
11:31:28	-9.54735	-13.21170	899	82	0.0	-9.5474997	-13.2093334	1491	ROV at 900m; descending without problems
11:32:26	-9.54738	-13.21170	943	280	0.0	-9.5474997	-13.2093334	1494	flushing KIPS system for the next couple of minutes
11:39:02	-9.54723	-13.21097	1200	279	0.0	-9.5474997	-13.2089996	1493	ROV at 1200m; no problems yet
11:42:58	-9.54730	-13.21033	1334	279	0.0	-9.5474997	-13.2088327	1494	ROV at 1400m; close to bottom; white balance
11:46:40	-9.54737	-13.21007	1458	280	0.0	-9.5474997	-13.2088327	1492	touch down is supposed to be west of Main Lilliput; than traverse for 100m east towards Main Lilliput
11:47:03	-9.54742	-13.21003	1472	280	25.8	-9.5474997	-13.2088327	1486	altimeter kicks in
11:48:20	-9.54742	-13.21002	1486	279	9.7	-9.5474997	-13.2088327	1490	AT THE BOTTOM
11:49:22	-9.54743	-13.21002	1488	348	6.8	-9.5474997	-13.2088327	1491	10 m above bottom; pillow lavas
11:49:44	-9.54745	-13.21000	1487	1	6.7	-9.5474997	-13.2088327	1488	Fe-oxides along fissure
11:49:46	-9.54745	-13.21000	1487	20	8.2	-9.5474997	-13.2088327	1489	fish
11:51:12	-9.54750	-13.20997	1492	132	3.2	-9.5474997	-13.2088327	1490	unwinding cable before moving
11:53:32	-9.54743	-13.20983	1497	92	3.4	-9.5474997	-13.2088327	1490	pillow lava, slightly sedimented
11:54:40	-9.54742	-13.20985	1498	92	3.9	-9.5474997	-13.2088327	1490	still image
11:55:10	-9.54742	-13.20985	1498	92	3.6	-9.5474997	-13.2088327	1492	at fissure, taken still image
11:56:06	-9.54740	-13.20982	1497	56	4.4	-9.5474997	-13.2088327	1490	HD ON
11:56:45	-9.54738	-13.20980	1498	15	3.9	-9.5474997	-13.2088327	1496	still image
11:56:55	-9.54738	-13.20980	1498	15	4.7	-9.5474997	-13.2088327	1492	HD OFF
11:57:10	-9.54738	-13.20980	1498	32	4.8	-9.5474997	-13.2088327	1493	turning to north loooking along fissure
11:57:26	-9.54742	-13.20978	1496	90	5.1	-9.5474997	-13.2088327	1494	pillow lava, unsedimented
11:58:20	-9.54740	-13.20967	1493	--	--	-9.5474997	-13.2088327	1492	pillow lava, unsedimented
11:59:21	-9.54740	-13.20957	1492	99	4.5	-9.5474997	-13.2088327	1491	pillow lava, unsedimented
11:59:33	-9.54610	-13.20983	1491	91	5.0	-9.5474997	-13.2088327	1488	slightlymoving uphill
12:00:30	-9.54733	-13.20942	1490	86	4.3	-9.5474997	-13.2088327	1491	HD ON
12:00:54	-9.54732	-13.20940	1491	87	3.3	-9.5474997	-13.2088327	1490	approaching Main Lilliput, visible in HD camera
12:01:02	-9.54733	-13.20938	1491	88	2.8	-9.5474997	-13.2088327	1490	mussel patch
12:02:27	-9.54725	-13.20932	1493	118	1.8	-9.5474997	-13.2088327	1494	HD OFF
12:02:52	-9.54723	-13.20933	1493	119	1.8	-9.5474997	-13.2088327	1493	still image
12:04:19	-9.54722	-13.20930	1494	163	0.9	-9.5474997	-13.2088327	1492	fish
12:06:16	-9.54722	-13.20930	1494	167	0.8	-9.5474997	-13.2088327	1490	in intense mussel bed
12:06:18	-9.54722	-13.20930	1494	166	0.8	-9.5474997	-13.2088327	1490	still image
12:06:19	-9.54722	-13.20930	1494	166	0.8	-9.5474997	-13.2088327	1490	still image
12:08:26	-9.54723	-13.20930	1494	167	0.8	-9.5474997	-13.2088327	1491	pillows with abundant small musels (more than in 2005?)
12:10:02	-9.54722	-13.20930	1494	167	0.8	-9.5474997	-13.2088327	1492	HD ON
12:10:44	-9.54723	-13.20930	1494	167	0.9	-9.5474997	-13.2088327	1493	still image
12:11:09	-9.54723	-13.20927	1492	166	2.0	-9.5474997	-13.2088327	1491	HD OFF
12:11:47	-9.54728	-13.20925	1492	127	1.7	-9.5474997	-13.2088327	1489	HD ON
12:13:20	-9.54730	-13.20918	1492	139	1.8	-9.5474997	-13.2088327	1489	HD OFF
12:14:37	-9.54730	-13.20917	1493	179	0.6	-9.5474997	-13.2088327	1489	approaching Marker MA
12:16:10	-9.54732	-13.20917	1493	179	0.6	-9.5474997	-13.2088327	1494	still image
12:17:37	-9.54732	-13.20918	1493	179	0.5	-9.5474997	-13.2088327	1493	diffuse flow (grew coloration in the water column above the holes)
12:19:28	-9.54730	-13.20917	1493	179	0.5	-9.5474997	-13.2088327	1494	HD ON
12:19:55	-9.54728	-13.20918	1493	179	0.5	-9.5474997	-13.2088327	1493	HD OFF
12:19:58	-9.54732	-13.20917	1493	179	0.5	-9.5474997	-13.2088327	1493	taking severalstill images
12:25:10	-9.54728	-13.20915	1493	179	0.6	-9.5474997	-13.2088327	1490	electronic marker L2 placed here
12:31:17	-9.54733	-13.20903	1490	101	3.5	-9.5474997	-13.2088327	1487	lift off, moving towards east
12:31:51	-9.54733	-13.20893	1492	94	3.3	-9.5474997	-13.2088327	1492	flew over thick Fe-oxides covering pillows
12:33:45	-9.54730	-13.20880	1493	94	1.7	-9.5474997	-13.2088327	1494	still image
12:34:13	-9.54728	-13.20882	1493	93	1.7	-9.5474997	-13.2088327	1495	back in pillows with patchy Fe-oxides
12:37:15	-9.54717	-13.20863	1492	79	3.4	-9.5474997	-13.2088327	1493	pillows with thich Fe-oxide cover
12:37:46	-9.54717	-13.20862	1491	181	3.3	-9.5474997	-13.2088327	1491	Pillows underneath; obviously on the other side of this small mound ?)
12:37:54	-9.54718	-13.20862	1492	178	2.8	-9.5474997	-13.2088327	1491	turning south for 15 m
12:39:54	-9.54732	-13.20862	1494	256	2.0	-9.5474997	-13.2088327	1494	HD ON
12:40:33	-9.54733	-13.20863	1493	276	2.6	-9.5474997	-13.2088327	1487	HD OFF
12:40:38	-9.54735	-13.20863	1494	276	2.2	-9.5474997	-13.2088327	1490	pillows with some Fe-oxides
12:41:03	-9.54735	-13.20870	1494	276	2.2	-9.5474997	-13.2088327	1491	turnig back west
12:41:54	-9.54737	-13.20877	1493	276	2.5	-9.5474997	-13.2088327	1491	pillow lava, > 50% sediment
12:44:00	-9.54743	-13.20895	1494	341	1.5	-9.5474997	-13.2088327	1492	Crinoid
12:44:21	-9.54743	-13.20895	1493	339	1.8	-9.5474997	-13.2088327	1492	HD ON
12:44:40	-9.54740	-13.20898	1493	339	1.8	-9.5474997	-13.2088327	1491	HD OFF
12:44:40	-9.54740	-13.20898	1493	339	1.8	-9.5474997	-13.2088327	1491	HD OFF
12:45:31	-9.54740	-13.20897	1492	358	2.3	-9.5474997	-13.2088327	1491	doing survey going from main lilliput to lustrog
12:46:06	-9.54732	-13.20902	1492	350	2.3	-9.5474997	-13.2088327	1494	pillows with iron crusts
12:46:33	-9.54728	-13.20903	1492	318	2.2	-9.5474997	-13.2088327	1492	dead mussels ahead
12:46:46	-9.54725	-13.20907	1492	313	2.2	-9.5474997	-13.2088327	1493	live mussels
12:47:30	-9.54727	-13.20910	1492	315	1.8	-9.5474997	-13.2088327	1493	marker MA
12:48:40	-9.54723	-13.20920	1492	9	2.2	-9.5474997	-13.2088327	1493	heading now 350°
12:49:35	-9.54710	-13.20923	1493	349	2.0	-9.5474997	-13.2088327	1491	pillow lava, > 50% sediment
12:50:18	-9.54698	-13.20932	1492	349	2.0	-9.5474997	-13.2088327	1490	little iron oxide mounds
12:51:00	-9.54692	-13.20937	1492	25	2.2	-9.5474997	-13.2088327	1493	fish
12:51:00	-9.54692	-13.20937	1492	25	2.2	-9.5474997	-13.2088327	1493	fish
12:51:23	-9.54690	-13.20937	1492	25	2.1	-9.5474997	-13.2088327	1493	another fish
12:52:09	-9.54672	-13.20935	1491	26	2.5	-9.5474997	-13.2088327	1489	lobate flow, > 50 % sediment
12:52:28	-9.54667	-13.20933	1492	25	2.6	-9.5474997	-13.2088327	1490	no lobate flow! wrong button!
12:52:31	-9.54663	-13.20935	1492	25	2.4	-9.5474997	-13.2088327	1490	pillow lava, > 50% sediment
12:54:34	-9.54632	-13.20925	1495	25	2.0	-9.5474997	-13.2088327	1493	lobate flow, unsedimented

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
12:55:13	-9.54623	-13.20923	1496	26	2.0	-9.5474997	-13.2088327	1493	still image
12:55:34	-9.54623	-13.20923	1496	28	2.2	-9.5474997	-13.2088327	1491	HD ON
12:57:39	-9.54623	-13.20927	1496	14	2.0	-9.5474997	-13.2088327	1494	HD OFF
12:58:10	-9.54623	-13.20925	1495	23	2.5	-9.5474997	-13.2088327	1492	lava pillars
12:58:25	-9.54620	-13.20927	1495	22	2.9	-9.5474997	-13.2088327	1495	lobate lava, unsedimented
12:58:52	-9.54615	-13.20927	1495	29	2.6	-9.5474997	-13.2088327	1491	skylights
12:59:32	-9.54607	-13.20925	1494	28	2.5	-9.5474997	-13.2088327	1494	lobate flow, unsedimented
13:00:38	-9.54588	-13.20922	1495	28	1.6	-9.5474997	-13.2088327	1489	going uphill
13:00:46	-9.54585	-13.20922	1495	28	2.1	-9.5474997	-13.2088327	1490	pillow lava, unsedimented
13:00:48	-9.54585	-13.20922	1495	28	2.0	-9.5474997	-13.2088327	1490	fish
13:02:12	-9.54562	-13.20917	1493	21	2.9	-9.5474997	-13.2088327	1492	something white in the HD
13:02:22	-9.54557	-13.20918	1493	23	2.7	-9.5474997	-13.2088327	1492	Crinoid
13:02:36	-9.54558	-13.20918	1493	22	2.6	-9.5474997	-13.2088327	1494	still image
13:03:17	-9.54552	-13.20918	1492	24	3.0	-9.5474997	-13.2088327	1493	pillow lava, unsedimented
13:05:47	-9.54535	-13.20917	1493	91	2.1	-9.5474997	-13.2088327	1491	Crinoid
13:07:07	-9.54532	-13.20913	1493	97	1.8	-9.5474997	-13.2088327	1490	gorgonia
13:07:24	-9.54530	-13.20912	1493	93	1.9	-9.5474997	-13.2088327	1491	going east towards mound
13:07:46	-9.54528	-13.20903	1492	94	1.9	-9.5474997	-13.2088327	1490	iron crusts
13:09:07	-9.54528	-13.20890	1486	89	4.4	-9.5473328	-13.2088327	1487	ground calors; rion oxides
13:09:10	-9.54528	-13.20890	1486	88	4.6	-9.5473328	-13.2088327	1487	HD ON
13:09:11	-9.54528	-13.20890	1486	88	4.5	-9.5473328	-13.2088327	1487	Crinoid
13:09:23	-9.54523	-13.20887	1485	89	4.5	-9.5473328	-13.2088327	1489	HD OFF
13:09:51	-9.54525	-13.20883	1483	87	6.3	-9.5471668	-13.2088327	1489	gorgonaria
13:10:16	-9.54530	-13.20880	1484	95	6.1	-9.5471668	-13.2088327	1489	HD ON
13:10:32	-9.54530	-13.20883	1484	97	6.9	-9.5471668	-13.2088327	1492	fissure, gorgonaria
13:10:42	-9.54530	-13.20885	1484	104	6.5	-9.5471668	-13.2088327	1489	still image
13:11:19	-9.54533	-13.20885	1486	--	--	-9.5469999	-13.2088327	1489	fissure
13:11:57	-9.54537	-13.20883	1486	112	4.0	-9.5469999	-13.2088327	1492	continuing ascend up mound
13:14:37	-9.54537	-13.20878	1481	--	--	-9.5466671	-13.2088327	1490	following the fissure of the mound
13:14:54	-9.54538	-13.20878	1481	72	5.3	-9.5466671	-13.2088327	1490	Crinoid
13:15:58	-9.54535	-13.20880	1483	55	3.7	-9.5465002	-13.2088327	1491	corals
13:17:51	-9.54533	-13.20878	1483	71	3.7	-9.5463333	-13.2088327	1490	looking on the right side of the wall of the fissure
13:21:38	-9.54530	-13.20872	1481	46	4.3	-9.5461674	-13.2088327	1494	HD ON
13:21:51	-9.54532	-13.20872	1481	46	5.8	-9.5461674	-13.2088327	1492	flow structure?
13:22:03	-9.54532	-13.20873	1481	46	4.9	-9.5461674	-13.2088327	1493	HD OFF
13:22:19	-9.54530	-13.20872	1481	56	4.3	-9.5461674	-13.2088327	1492	HD ON
13:22:51	-9.54532	-13.20872	1481	56	4.3	-9.5461674	-13.2088327	1492	lava pillars at the botttom
13:22:55	-9.54530	-13.20872	1481	56	4.3	-9.5461674	-13.2088327	1493	HD OFF
13:24:39	-9.54525	-13.20872	1480	2	3.0	-9.5461674	-13.2088327	1493	coral
13:25:59	-9.54523	-13.20870	1483	353	1.8	-9.5461674	-13.2088327	1493	HD ON
13:27:11	-9.54528	-13.20870	1480	--	--	-9.5461674	-13.2088327	1492	massiv flow with columnar joints
13:27:12	-9.54528	-13.20870	1480	11	3.2	-9.5461674	-13.2088327	1492	HD OFF
13:28:56	-9.54522	-13.20870	1482	10	4.3	-9.5461674	-13.2088327	1493	HD ON
13:29:50	-9.54518	-13.20873	1480	10	5.3	-9.5461674	-13.2088327	1494	crater, horizontal colums
13:30:42	-9.54522	-13.20870	1480	345	6.8	-9.5461674	-13.2088327	1494	HD OFF
13:31:10	-9.54520	-13.20868	1474	306	9.4	-9.5461674	-13.2088327	1492	crater depth 7 m
13:34:03	-9.54553	-13.20890	1490	270	2.9	-9.5461674	-13.2088327	1492	lobate flows stacked
13:36:37	-9.54550	-13.20960	1492	269	2.7	-9.5461674	-13.2088327	1491	lobate flow, slightly sedimented
13:37:11	-9.54550	-13.20968	1493	269	2.1	-9.5461674	-13.2088327	1494	still image
13:39:30	-9.54560	-13.21000	1495	268	1.6	-9.5461674	-13.2089996	1493	
13:40:14	-9.54557	-13.21012	1495	270	2.2	-9.5461674	-13.2089996	1492	climbing the hill with axial valley
13:40:18	-9.54557	-13.21012	1495	270	1.9	-9.5461674	-13.2089996	1491	lobate flow, > 50 % sediment
13:40:22	-9.54560	-13.21007	1495	270	2.5	-9.5461674	-13.2089996	1491	pillow lava, slightly sedimented
13:41:19	-9.54550	-13.21010	1492	324	3.6	-9.5461674	-13.2089996	1493	before, looking into the valley east of the hill
13:43:41	-9.54545	-13.21027	1490	280	7.2	-9.5461674	-13.2089996	1495	heading to the bottom of the valley
13:44:03	-9.54542	-13.21032	1487	253	10.7	-9.5461674	-13.2089996	1493	depth 10 m
13:44:21	-9.54543	-13.21032	1487	262	11.6	-9.5461674	-13.2089996	1496	10 x 17 x 10 m size of the sink
13:44:36	-9.54542	-13.21025	1490	261	9.2	-9.5461674	-13.2089996	1494	pillow lava, unsedimented
13:45:21	-9.54545	-13.21023	1497	262	2.7	-9.5461674	-13.2089996	1493	steep wall of pillows
13:48:57	-9.54548	-13.21042	1483	273	4.8	-9.5461674	-13.2091665	1492	climbing the east flank of the LUSTROG hill with axial valley
13:49:22	-9.54547	-13.21050	1481	271	3.4	-9.5461674	-13.2091665	1493	pillow lava, unsedimented
13:50:29	-9.54552	-13.21063	1477	270	6.4	-9.5461674	-13.2091665	1493	probably pillow mound
13:50:48	-9.54550	-13.21062	1476	269	7.3	-9.5461674	-13.2091665	1493	heading to North along the ax. valley
13:51:52	-9.54552	-13.21067	1476	278	4.8	-9.5461674	-13.2091665	1492	pillow lava, slightly sedimented
13:53:12	-9.54555	-13.21075	1474	296	3.9	-9.5461674	-13.2091665	1491	still image from the valley, now horizontal in the picture
13:53:15	-9.54555	-13.21075	1474	296	3.6	-9.5461674	-13.2091665	1491	still image
13:53:43	-9.54558	-13.21073	1475	296	3.0	-9.5461674	-13.2091665	1496	still image
13:54:40	-9.54555	-13.21077	1475	266	3.0	-9.5461674	-13.2093334	1496	valley is m-wide sharp graben
13:54:55	-9.54557	-13.21077	1475	259	3.5	-9.5461674	-13.2093334	1493	HD ON
13:55:14	-9.54558	-13.21078	1475	246	3.4	-9.5461674	-13.2093334	1495	HD OFF
13:56:59	-9.54570	-13.21082	1478	181	3.7	-9.5461674	-13.2093334	1493	~ 4m depth axial graben
13:58:16	-9.54580	-13.21080	1476	170	4.3	-9.5461674	-13.2093334	1494	HD ON
13:58:18	-9.54580	-13.21080	1476	172	4.4	-9.5461674	-13.2093334	1494	HD OFF
13:59:28	-9.54590	-13.21075	1475	179	5.4	-9.5461674	-13.2093334	1496	ROV map probably offset of 17m to the west
14:00:09	-9.54597	-13.21073	1477	181	4.8	-9.5461674	-13.2093334	1494	impressive, sharp rupture, within pillow bas
14:00:44	-9.54607	-13.21073	1478	182	5.8	-9.5461674	-13.2093334	1493	Fly for several decameters along the rupture
14:04:34	-9.54660	-13.21063	1479	215	8.0	-9.5461674	-13.2095003	1494	again at the bottom, rupture still visible
14:05:24	-9.54670	-13.21063	1480	196	6.1	-9.5461674	-13.2095003	1493	discrepancy with map: should pass a valley, but we are still on the hill with rupture
14:06:29	-9.54677	-13.21058	1480	114	6.2	-9.5461674	-13.2096672	1492	according map, we climbing now the next hill following the rupture
14:06:47	-9.54675	-13.21053	1481	93	3.4	-9.5461674	-13.2096672	1494	now heading with 110 to Lilliput
14:07:53	-9.54673	-13.21038	1489	95	1.2	-9.5461674	-13.2096672	1496	heading down to the valley west of Main Lilliput
14:08:43	-9.54610	-13.20920	1494	94	2.3	-9.5461674	-13.2096672	1499	flying over the next rupture also running N-S
14:09:04	-9.54670	-13.21020	1493	94	5.2	-9.5461674	-13.2095003	1494	lobate flow, slightly sedimented

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
14:10:31	-9.54665	-13.20993	1495	66	4.5	-9.5461674	-13.2096672	1496	probably first mussels
14:11:34	-9.54657	-13.20973	1493	100	3.7	-9.5461674	-13.2096672	1495	passing the deepest part ofthe valley
14:11:37	-9.54657	-13.20973	1493	99	3.9	-9.5461674	-13.2096672	1495	lobate flow, slightly sedimented
14:12:41	-9.54653	-13.20952	1491	104	3.6	-9.5461674	-13.2096672	1496	pillow lava, slightly sedimented
14:14:42	-9.54655	-13.20925	1492	95	2.7	-9.5461674	-13.2096672	1499	hydroxide oxide crusts visible
14:15:05	-9.54655	-13.20923	1493	98	2.0	-9.5461674	-13.2096672	1497	still image
14:17:39	-9.54657	-13.20917	1491	174	3.5	-9.5461674	-13.2096672	1495	still image
14:18:52	-9.54667	-13.20920	1490	182	2.9	-9.5461674	-13.2096672	1495	HD ON
14:19:22	-9.54672	-13.20918	1491	176	2.1	-9.5461674	-13.2096672	1493	HD from custs on pillows
14:19:43	-9.54673	-13.20918	1490	172	3.4	-9.5461674	-13.2096672	1491	fish
14:19:44	-9.54673	-13.20918	1490	172	3.4	-9.5461674	-13.2096672	1494	HD OFF
14:21:25	-9.54682	-13.20918	1489	182	3.7	-9.5463333	-13.2095003	1493	still image
14:24:18	-9.54710	-13.20908	1490	174	3.6	-9.5466671	-13.2095003	1493	mussel patch
14:25:26	-9.54723	-13.20903	1491	172	2.4	-9.5466671	-13.2093334	1493	musselbeds in sight
14:34:02	-9.54725	-13.20910	1492	275	1.7	-9.5476665	-13.2089996	1488	looking for a spot to put die fasts down
14:34:30	-9.54725	-13.20910	1492	280	1.7	-9.5476665	-13.2089996	1487	HD ON
14:35:10	-9.54725	-13.20908	1492	287	1.1	-9.5476665	-13.2089996	1488	HD OFF
14:42:46	-9.54728	-13.20910	1493	287	0.7	-9.5483332	-13.2088327	1490	moving die fast off the porch
14:44:08	-9.54725	-13.20908	1493	287	0.7	-9.5483332	-13.2088327	1489	HD ON
14:45:10	-9.54723	-13.20908	1493	287	0.8	-9.5483332	-13.2088327	1489	HD OFF
14:49:36	-9.54727	-13.20905	1493	287	0.8	-9.5483332	-13.2088327	1489	getting ready to position smoni
14:52:11	-9.54728	-13.20908	1493	287	0.8	-9.5483332	-13.2088327	1487	puttin smoni into hole
14:52:35	-9.54722	-13.20908	1493	287	0.8	-9.5483332	-13.2088327	1490	**smoni 319 ROV 1**
14:55:31	-9.54720	-13.20913	1493	288	0.6	-9.5483332	-13.2088327	1490	smoni put out
14:56:24	-9.54730	-13.20905	1493	287	0.7	-9.5483332	-13.2088327	1489	still image
14:56:29	-9.54730	-13.20905	1493	287	0.7	-9.5483332	-13.2088327	1489	foto smoni
14:58:27	-9.54732	-13.20908	1493	288	0.7	-9.5483332	-13.2088327	1489	moving second smoni on the left side of the porch
15:07:11	-9.54727	-13.20908	1493	287	0.7	-9.5485001	-13.2088327	1492	HD ON
15:09:25	-9.54727	-13.20908	1493	287	0.7	-9.5485001	-13.2088327	1490	positioning KIPS intosamewhole
15:09:26	-9.54727	-13.20908	1493	287	0.7	-9.5485001	-13.2088327	1491	HD OFF
15:12:55	-9.54732	-13.20912	1493	288	0.7	-9.548667	-13.2088327	1489	**319 ROV 2 (KIPS C7)**
15:18:31	-9.54730	-13.20908	1493	287	0.7	-9.548667	-13.2088327	1490	KIPS OFF
15:18:46	-9.54730	-13.20910	1493	287	0.7	-9.548667	-13.2088327	1489	KIPS ON
15:18:47	-9.54730	-13.20910	1493	287	0.7	-9.548667	-13.2088327	1489	**319 ROV 3 (KIPS C8)**
15:20:36	-9.54728	-13.20910	1493	--	--	-9.548667	-13.2088327	1489	still image
15:21:28	-9.54727	-13.20908	1493	287	0.7	-9.548667	-13.2088327	1492	still image
15:22:40	-9.54727	-13.20910	1493	287	0.8	-9.548667	-13.2088327	1494	still image
15:24:09	-9.54727	-13.20908	1493	287	0.7	-9.548667	-13.2088327	1489	KIPS OFF
15:24:26	-9.54730	-13.20907	1493	287	0.7	-9.548667	-13.2088327	1489	KIPS ON
15:24:27	-9.54730	-13.20907	1493	287	0.7	-9.548667	-13.2088327	1489	**319 ROV 4 (KIPS C9)**
15:29:37	-9.54727	-13.20910	1493	287	0.7	-9.548667	-13.2088327	0	KIPS OFF
15:34:02	-9.54727	-13.20912	1493	287	0.7	-9.548667	-13.2088327	0	handover of pilots
15:54:55	-9.54730	-13.20913	1493	284	0.2	-9.5481672	-13.2088327	0	put out DieFast1 on soft Fe oxides
15:55:19	-9.54723	-13.20912	1492	270	1.2	-9.5481672	-13.2088327	0	fly back to sampling crack
15:56:47	-9.54725	-13.20913	1493	220	0.3	-9.5481672	-13.2088327	0	land close to DieFast 2
15:58:28	-9.54728	-13.20910	1493	214	0.4	-9.5481672	-13.2088327	0	pick up DieFast 2
16:01:16	-9.54718	-13.20903	1493	240	0.6	-9.5481672	-13.2088327	0	HD ON
16:02:19	-9.54722	-13.20912	1493	241	0.6	-9.5481672	-13.2088327	0	HD OFF
16:02:43	-9.54720	-13.20913	1493	240	0.6	-9.5481672	-13.2088327	0	put down DieFast 2 to right of DieFast 1
16:05:13	-9.54722	-13.20915	1493	240	0.6	-9.5481672	-13.2088327	0	lift up DieFast 2 again, location is too uneven
16:08:46	-9.54723	-13.20913	1493	198	0.3	-9.5481672	-13.2088327	0	still image
16:09:07	-9.54722	-13.20915	1493	198	0.3	-9.5481672	-13.2088327	0	photo of twoo DieFasts
16:19:35	-9.54720	-13.20915	1493	--	--	-9.5481672	-13.2088327	0	heading some meters to NW to find another mussel patch for sampling
16:20:42	-9.54720	-13.20915	1493	--	--	-9.5481672	-13.2088327	0	heading to N
16:23:32	-9.54725	-13.20920	1492	89	1.9	-9.5481672	-13.2088327	0	searching for the right mussel patch
16:30:34	-9.54722	-13.20905	1494	278	0.3	-9.5481672	-13.2088327	0	place found, ROV placed
16:32:04	-9.54723	-13.20907	1494	283	0.3	-9.5481672	-13.2088327	0	Die fasts are some meters W of us
16:33:31	-9.54722	-13.20908	1494	286	0.3	-9.5481672	-13.2088327	0	starting to sample mussels with the scoop net
16:36:45	-9.54722	-13.20908	1494	291	0.2	-9.5481672	-13.2088327	0	**sample 319 ROV 5 (mussel net)**
16:37:06	-9.54690	-13.20970	1494	284	0.3	-9.5481672	-13.2088327	0	first bunch of mussels in the net
16:37:23	-9.54725	-13.20908	1494	283	0.3	-9.5481672	-13.2088327	0	second bunch
16:38:55	-9.54722	-13.20908	1494	281	0.2	-9.5481672	-13.2088327	0	third and fourth bunch
16:40:25	-9.54722	-13.20908	1494	282	0.3	-9.5481672	-13.2088327	0	net dropped in the back of the drawer
16:41:33	-9.54738	-13.20898	1494	282	0.3	-9.5481672	-13.2088327	0	# not clear yet; clarified later
16:45:19	-9.54720	-13.20907	1494	285	0.2	-9.5481672	-13.2088327	0	finished biosampling (finally! :-)); next short exploration program to the east of Lilliput
16:47:41	-9.54413	-13.20777	1491	276	2.4	-9.5481672	-13.2088327	0	next target is small seamount 200m SE (bearing 135) from Main Lilliput
16:49:31	-9.54727	-13.20887	1492	135	2.2	-9.5483332	-13.2086668	0	Fe-oxide covered pillow lava
16:50:38	-9.54735	-13.20888	1493	150	1.7	-9.5483332	-13.2086668	0	still image
16:50:40	-9.54735	-13.20888	1493	149	1.8	-9.5483332	-13.2086668	0	now flying 135°, pillows
16:50:56	-9.54737	-13.20888	1492	148	2.2	-9.5483332	-13.2086668	0	small fissure with Fe-coating on the inside
16:51:53	-9.54737	-13.20880	1493	140	2.5	-9.5485001	-13.2084999	0	pillows with 10% Fe-oxide coating, small chimneys
16:53:12	-9.54753	-13.20862	1495	142	1.7	-9.548667	-13.2084999	0	large pillows with fewer Fe-oxides
16:54:19	-9.54767	-13.20853	1495	143	2.2	-9.548667	-13.208333	0	pillow lava, unsedimented
16:55:00	-9.54775	-13.20840	1494	142	2.2	-9.548667	-13.208333	0	piled lava ; pillows slightly younger? no more Fe-oxides
16:56:09	-9.54792	-13.20832	1493	143	2.1	-9.5488329	-13.2081671	0	large pillows, unsedimented
16:57:18	-9.54808	-13.20817	1492	154	1.3	-9.5488329	-13.2081671	0	more lobate flows, little sediment in pockets; but same younger looking flow
16:57:52	-9.54817	-13.20813	1492	148	0.7	-9.5489998	-13.2081671	0	HD ON
16:58:25	-9.54822	-13.20807	1491	148	1.2	-9.5489998	-13.2080002	0	HD OFF
16:59:12	-9.54830	-13.20798	1490	150	2.5	-9.5489998	-13.2080002	0	increasing coral density, approaching pillow mound
16:59:45	-9.54838	-13.20793	1490	153	2.0	-9.5489998	-13.2080002	0	still lobate flows and a few corals

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:01:25	-9.54857	-13.20788	1486	191	4.3	-9.5491667	-13.2078333	0	pillow mound still climbing; more lobate than pillows
17:01:45	-9.54858	-13.20788	1482	191	7.7	-9.5491667	-13.2078333	0	pillow talus ahead and small fissure
17:02:02	-9.54862	-13.20788	1482	--	--	-9.5493326	-13.2078333	0	HD ON
17:02:42	-9.54867	-13.20793	1481	185	2.5	-9.5493326	-13.2076674	0	massive flow cut by fissure
17:03:22	-9.54863	-13.20792	1475	206	11.3	-9.5493326	-13.2076674	0	columnar joints as talus
17:05:24	-9.54870	-13.20800	1472	169	6.1	-9.5495005	-13.2075005	0	rotated block with jointing
17:05:42	-9.54870	-13.20795	1475	165	0.9	-9.5495005	-13.2075005	0	HD OFF
17:07:24	-9.54875	-13.20785	1475	129	5.7	-9.5496674	-13.2073326	0	HD OFF
17:07:33	-9.54877	-13.20783	1474	127	5.7	-9.5496674	-13.2073326	0	still image
17:08:04	-9.54875	-13.20783	1473	95	8.0	-9.5496674	-13.2073326	0	coral at steep slpe, continue uphill
17:08:46	-9.54882	-13.20780	1470	161	8.0	-9.5498333	-13.2073326	0	top at 1472m, targeting next hilltop slightly to the south (belonging to the same edifice)
17:10:24	-9.54882	-13.20772	1480	207	3.5	-9.5498333	-13.2073326	0	HD ON
17:10:51	-9.54878	-13.20770	1479	213	3.0	-9.5498333	-13.2073326	0	HD OFF
17:11:41	-9.54883	-13.20770	1478	210	5.5	-9.5498333	-13.2071667	0	still image
17:11:53	-9.54887	-13.20770	1478	221	6.4	-9.5498333	-13.2071667	0	this hilltop is again columnar jointed massive flows
17:12:52	-9.54892	-13.20773	1482	303	5.6	-9.5498333	-13.2071667	0	still image
17:13:25	-9.54895	-13.20773	1480	326	7.5	-9.5498333	-13.2071667	0	still image
17:13:54	-9.54893	-13.20772	1478	302	9.1	-9.5498333	-13.2071667	0	numerous columnar joints, tilted block again
17:16:11	-9.54892	-13.20787	1472	310	4.9	-9.5498333	-13.2071667	0	pillow surface to the left and columnar joints to the right
17:16:12	-9.54892	-13.20787	1472	309	4.6	-9.5498333	-13.2071667	0	HD OFF
17:16:14	-9.54892	-13.20787	1472	311	5.1	-9.5498333	-13.2071667	0	still image
17:18:01	-9.54888	-13.20790	1474	321	1.8	-9.5498333	-13.2073326	0	need to fly back to Main Lilliput
17:18:09	-9.54887	-13.20790	1476	320	3.3	-9.5498333	-13.2071667	0	turning NW
17:19:14	-9.54872	-13.20810	1481	330	4.3	-9.5498333	-13.2073326	0	flying over talus piles, partially loosing ground because of the slope
17:19:43	-9.54872	-13.20815	1488	331	1.7	-9.5496674	-13.2073326	0	in pillows, unsedimented, but not fresh
17:21:04	-9.54862	-13.20828	1491	346	1.6	-9.5495005	-13.2073326	0	pillows and lobates, unsedimented
17:21:43	-9.54857	-13.20837	1492	--	--	-9.5495005	-13.2075005	0	ship needs to catch up with us
17:22:12	-9.54850	-13.20845	1492	327	1.9	-9.5495005	-13.2075005	0	
17:22:30	-9.54848	-13.20848	1493	325	1.0	-9.5493326	-13.2075005	0	pillows
17:23:25	-9.54835	-13.20858	1492	328	2.0	-9.5493326	-13.2076674	0	Gorgonia
17:23:57	-9.54833	-13.20867	1492	328	1.7	-9.5491667	-13.2076674	0	first appearence of Fe-oxides in interstices
17:24:19	-9.54830	-13.20870	1492	329	1.5	-9.5491667	-13.2076674	0	coral
17:24:48	-9.54827	-13.20870	1492	330	1.8	-9.5491667	-13.2078333	0	increasing Fe-oxide cover
17:25:00	-9.54822	-13.20875	1492	328	2.2	-9.5491667	-13.2078333	0	pillows with more sediment, this is older lava
17:25:51	-9.54818	-13.20882	1493	327	1.1	-9.5489998	-13.2078333	0	less Fe-oxide cover, coral
17:26:16	-9.54810	-13.20887	1492	329	1.9	-9.5489998	-13.2080002	0	large pillows with Fe-oxides (10%)
17:27:27	-9.54800	-13.20893	1492	352	1.6	-9.5488329	-13.2080002	0	turning to a more northerly course to get to Main Lilliput
17:27:34	-9.54797	-13.20895	1491	353	1.6	-9.5488329	-13.2080002	0	pillow lava, slightly sedimented
17:27:44	-9.54797	-13.20898	1492	353	1.0	-9.548667	-13.2081671	0	few Fe-oxides
17:28:56	-9.54780	-13.20908	1491	351	1.3	-9.548667	-13.2081671	0	fractured flowtops, few Fe-oxides
17:29:16	-9.54775	-13.20908	1491	355	1.2	-9.5485001	-13.208333	0	pillow lava, slightly sedimented
17:29:51	-9.54765	-13.20915	1490	8	1.8	-9.5485001	-13.208333	0	pillow lava, slightly sedimented
17:30:33	-9.54755	-13.20918	1490	7	1.2	-9.5483332	-13.208333	0	fractured flowtops, more shett-like appearence
17:31:06	-9.54747	-13.20920	1491	17	0.8	-9.5483332	-13.2084999	0	increasing Fe-oxide cover
17:31:36	-9.54423	-13.20780	1492	23	0.9	-9.5483332	-13.2084999	0	intense Fe-oxides
17:31:59	-9.54733	-13.20915	1492	32	1.3	-9.5481672	-13.2084999	0	white patches ahead
17:32:16	-9.54733	-13.20915	1491	32	2.1	-9.5481672	-13.2086668	0	approaching Die Fast`s
17:33:47	-9.54727	-13.20912	1492	306	2.0	-9.5480003	-13.2086668	0	HD OFF
17:33:58	-9.54727	-13.20912	1492	292	2.0	-9.5480003	-13.2086668	0	try to settle near SMoni
17:37:23	-9.54730	-13.20913	1492	102	1.5	-9.5480003	-13.2086668	0	still image
17:37:36	-9.54728	-13.20913	1492	104	1.6	-9.5480003	-13.2086668	0	moved to the western side of the mussel patch
17:38:26	-9.54418	-13.20778	1493	108	0.7	-9.5480003	-13.2086668	0	touchdown next to mussels and fluid holes
17:40:29	-9.54725	-13.20913	1493	98	0.5	-9.5480003	-13.2086668	0	trying to position ourselves for best sampling point
17:42:17	-9.54727	-13.20913	1493	113	0.4	-9.5480003	-13.2086668	0	HD ON
17:42:42	-9.54727	-13.20915	1493	112	0.5	-9.5480003	-13.2086668	0	HD OFF
17:43:26	-9.54727	-13.20913	1493	113	0.5	-9.5480003	-13.2086668	0	still image
17:43:33	-9.54727	-13.20913	1493	113	0.5	-9.5480003	-13.2086668	0	still image
17:43:38	-9.54728	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	still image
17:48:09	-9.54728	-13.20910	1493	112	0.5	-9.5480003	-13.2086668	0	taking KIPS handle
17:48:19	-9.54727	-13.20910	1493	112	0.4	-9.5480003	-13.2086668	0	retrieving handle
17:49:52	-9.54725	-13.20912	1493	113	0.5	-9.5480003	-13.2086668	0	T= 5.3, 6, 7, 7.6, 7.9,
17:52:10	-9.54727	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	trying to get deeper into the hole; T= 8.4,
17:52:38	-9.54728	-13.20915	1493	113	0.5	-9.5480003	-13.2086668	0	within the mussels, 5.5°C, 7.8
17:52:43	-9.54728	-13.20915	1493	112	0.5	-9.5480003	-13.2086668	0	KIPS ON
17:52:45	-9.54728	-13.20915	1493	112	0.5	-9.5480003	-13.2086668	0	**319 ROV 6 (KIPS A2)**
17:53:57	-9.54725	-13.20915	1493	112	0.5	-9.5480003	-13.2086668	0	still image
17:54:09	-9.54803	-13.20853	1493	112	0.5	-9.5480003	-13.2086668	0	KIPS bottle A2; T= 8.5°C within musselbed
17:57:06	-9.54728	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	HD ON
17:57:32	-9.54727	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	HD OFF
17:58:05	-9.54730	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	KIPS OFF
17:58:23	-9.54727	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	KIPS ON
17:58:26	-9.54727	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	**319 ROV 7 (KIPS A3)**
17:58:46	-9.54727	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	KIPS bottle A3; T=8.6°C
17:59:40	-9.54727	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	T= raised to 8.9°C, the same reading as within the fissure directly = broad upwelling?
18:04:05	-9.54730	-13.20918	1493	113	0.5	-9.5480003	-13.2086668	0	KIPS OFF
18:04:44	-9.54732	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	interesting to sea the small size of the mussels when compared to 2005; shouldn`t they be bigger??
18:05:39	-9.54987	-13.21242	1493	112	0.5	-9.5480003	-13.2086668	0	finished KIPS sampling; packing and prepare for "die fast`s"

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
18:09:09	-9.54727	-13.20912	1493	113	0.4	-9.5480003	-13.2086668	0	grabbing shovel
18:10:38	-9.54730	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	still image
18:11:44	-9.54728	-13.20913	1493	112	0.5	-9.5480003	-13.2086668	0	still image
18:14:23	-9.54725	-13.20913	1493	112	0.4	-9.5480003	-13.2086668	0	foto with shoveltaking mussels (pan2 should be 27°)
18:18:11	-9.54730	-13.20912	1493	112	0.5	-9.5480003	-13.2086668	0	first few attempts to sample mussels with shovel failed (hard substrate, wrong angle, resistence)
18:25:20	-9.54725	-13.20913	1493	113	0.4	-9.5480003	-13.2086668	0	still trying to sample mussels; not an easy job with tiny mussels attached to a rough basalt
18:32:45	-9.54728	-13.20912	1494	112	0.3	-9.5480003	-13.2086668	0	**319 ROV 8, small scoop of mussels for "die fast 2"**
18:34:40	-9.54725	-13.20913	1493	114	1.3	-9.5480003	-13.2086668	0	lift off for die fast2
18:36:04	-9.54720	-13.20913	1491	176	2.7	-9.5480003	-13.2086668	0	HD ON
18:37:18	-9.54720	-13.20913	1493	199	0.4	-9.5480003	-13.2086668	0	HD OFF
18:41:33	-9.54723	-13.20913	1494	198	0.3	-9.5480003	-13.2086668	0	opening diefast
18:46:21	-9.54720	-13.20915	1494	198	0.3	-9.5480003	-13.2086668	0	putting shovel with mussels into die fast 2
18:46:49	-9.54723	-13.20915	1494	198	0.3	-9.5480003	-13.2086668	0	do we have a sample number for this mussel????? (changed protocol shifts!!)
18:48:59	-9.54722	-13.20913	1494	198	0.3	-9.5480003	-13.2086668	0	mussels in die fast 2
18:52:02	-9.54723	-13.20913	1494	198	0.3	-9.5480003	-13.2086668	0	put doen shovel on greay box
18:54:24	-9.54723	-13.20913	1494	198	0.4	-9.5480003	-13.2086668	0	moving vehicel forward because tto far away for closing lid of die fast 2
18:56:32	-9.54723	-13.20913	1494	198	0.4	-9.5480003	-13.2086668	0	closing lid of die fast 2
18:58:56	-9.54720	-13.20913	1494	198	0.3	-9.5480003	-13.2086668	0	pulling trigger for mgcl2
19:00:58	-9.54722	-13.20913	1493	267	0.4	-9.5480003	-13.2086668	0	HD ON
19:01:06	-9.54722	-13.20912	1494	277	0.3	-9.5480003	-13.2086668	0	HD OFF
19:08:07	-9.54723	-13.20913	1493	290	0.2	-9.5480003	-13.2086668	0	open die fast 1
19:09:59	-9.54725	-13.20912	1493	290	0.2	-9.5480003	-13.2086668	0	picking up shovel
19:12:04	-9.54723	-13.20912	1492	219	2.5	-9.5480003	-13.2086668	0	moving back to mussel patch
19:15:24	-9.54728	-13.20913	1494	117	0.5	-9.5480003	-13.2086668	0	landed at the mussel patch
19:20:57	-9.54808	-13.20825	1494	119	0.5	-9.5480003	-13.2086668	0	**collected some baby mussels, 319 ROV 9, mussel net**
19:22:06	-9.54728	-13.20915	1493	119	1.3	-9.5480003	-13.2086668	0	flying to die fast 1
19:26:25	-9.54723	-13.20913	1494	261	0.4	-9.5480003	-13.2086668	0	mussels in die fast 1
19:28:27	-9.54723	-13.20912	1494	260	0.4	-9.5480003	-13.2086668	0	cannot get all the mussels out of the shovel
19:29:39	-9.54720	-13.20912	1494	259	0.4	-9.5480003	-13.2086668	0	placing shovel back into drawer
19:30:54	-9.54722	-13.20912	1494	261	0.4	-9.5480003	-13.2086668	0	closing draw
19:32:53	-9.54725	-13.20913	1494	261	0.3	-9.5480003	-13.2086668	0	closing lid of die fast 1
19:35:37	-9.54720	-13.20913	1494	260	0.4	-9.5480003	-13.2086668	0	trigger of die fast 1 pulled
19:39:21	-9.54727	-13.20915	1492	120	1.8	-9.5480003	-13.2086668	0	flying bakc to mussel spot
19:44:55	-9.54727	-13.20913	1494	121	0.4	-9.5480003	-13.2086668	0	had shift change of pilots
19:45:30	-9.54730	-13.20913	1494	121	0.4	-9.5480003	-13.2086668	0	want to collect mussel net
19:46:03	-9.54730	-13.20913	1494	121	0.4	-9.5480003	-13.2086668	0	opening grey box
19:48:05	-9.54730	-13.20910	1494	--	--	-9.5480003	-13.2086668	0	taking mussel net from draw
19:52:58	-9.54728	-13.20915	1494	--	--	-9.5480003	-13.2086668	0	**319 ROV 10, mussel net**
19:58:18	-9.54728	-13.20913	1494	117	0.5	-9.5480003	-13.2086668	0	still collecting mussel net
20:00:12	-9.54730	-13.20913	1494	117	0.5	-9.5480003	-13.2086668	0	closed grey box
20:02:48	-9.54727	-13.20913	1494	117	0.4	-9.5480003	-13.2086668	0	HD OFF
20:02:57	-9.54727	-13.20913	1494	117	0.4	-9.5480003	-13.2086668	0	HD ON
20:04:20	-9.54727	-13.20917	1491	90	2.6	-9.5480003	-13.2086668	0	seeing diefasts
20:06:26	-9.54722	-13.20915	1494	193	0.3	-9.5480003	-13.2086668	0	HD OFF
20:11:00	-9.54722	-13.20912	1494	186	0.4	-9.5480003	-13.2086668	0	pulling second trigger at die fast 2
20:14:28	-9.54722	-13.20912	1494	185	0.4	-9.5480003	-13.2086668	0	collecting die fast 2 nd positioning it on the porch
20:19:47	-9.54723	-13.20910	1493	214	1.5	-9.5480003	-13.2086668	0	HD ON
20:21:10	-9.54725	-13.20910	1493	227	1.1	-9.5480003	-13.2086668	0	going back to fluid spot where smoni is standing for sampling of fludis during tidal high
20:22:51	-9.54727	-13.20908	1493	267	0.8	-9.5480003	-13.2086668	0	HD OFF
20:25:33	-9.54728	-13.20908	1494	256	0.5	-9.5480003	-13.2086668	0	HD ON
20:25:52	-9.54727	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	white bacterial mats
20:26:02	-9.54727	-13.20912	1494	254	0.6	-9.5480003	-13.2086668	0	HD OFF
20:29:18	-9.54728	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	grabbing nozzle handle from kips
20:33:10	-9.54708	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS ON
20:33:41	-9.54728	-13.20910	1494	255	0.5	-9.5480003	-13.2086668	0	**319 ROV 11 (KIPS B4)**
20:38:22	-9.54727	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS OFF
20:38:40	-9.54728	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS ON
20:38:41	-9.54728	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	**319 ROV 12 (KIPS B5)**
20:44:06	-9.54727	-13.20910	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS OFF
20:44:13	-9.54725	-13.20908	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS ON
20:44:14	-9.54725	-13.20908	1494	255	0.5	-9.5480003	-13.2086668	0	**319 ROV 13 (KIPS B6)**
20:49:04	-9.54728	-13.20913	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS OFF
20:49:34	-9.54730	-13.20910	1494	255	0.5	-9.5480003	-13.2086668	0	KIPS ON
20:49:34	-9.54730	-13.20910	1494	255	0.5	-9.5480003	-13.2086668	0	**319 ROV 14 (KIPS A1)**
20:50:51	-9.54727	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	temperature constant at 8-9°C
20:52:16	-9.54723	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	temperature drop to 6°C
20:53:44	-9.54725	-13.20912	1494	255	0.5	-9.5480003	-13.2086668	0	still image
20:55:14	-9.54728	-13.20913	1494	--	--	-9.5480003	-13.2086668	0	KIPS OFF
20:55:26	-9.54727	-13.20915	1494	255	0.5	-9.5480003	-13.2086668	0	dosierpump on
20:57:09	-9.54725	-13.20913	1494	--	--	-9.5480003	-13.2086668	0	dosierpump off
21:00:01	-9.54727	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	KIPS nozzle back in spot
21:00:23	-9.54725	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	getting the slurp gun ready to try and slurp some of the bacterial mat see HD
21:00:40	-9.54727	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	HD ON
21:01:10	-9.54725	-13.20912	1494	254	0.4	-9.5480003	-13.2086668	0	HD OFF
21:02:51	-9.54725	-13.20910	1494	254	0.4	-9.5480003	-13.2086668	0	**slurping mat 319 ROV 15**
21:07:47	-9.54733	-13.20908	1494	256	0.4	-9.5480003	-13.2086668	0	stop slurping
21:10:23	-9.54725	-13.20912	1494	255	0.4	-9.5480003	-13.2086668	0	putting slurp gun back

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
21:12:26	-9.54725	-13.20915	1492	50	2.6	-9.5480003	-13.2086668	0	going to die fast1 for its collection
21:17:25	-9.54723	-13.20913	1494	333	0.3	-9.5480003	-13.2086668	0	collecting die fast 1
21:18:29	-9.54725	-13.20912	1494	333	0.3	-9.5480003	-13.2086668	0	positioning die fast on porch
21:24:02	-9.54727	-13.20910	1494	334	0.3	-9.5480003	-13.2086668	0	ascending

Cruise: MAR SOUTH V
Date: 30.04.2009
Station: M78-2_324ROV
Targets: Lilliput

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
11:13:42	0.00000	0.00000	0	--	--	-9.545	-13.21367	1508	IN THE WATER
11:51:03	-9.54318	-13.21352	1504	90	25.5	-9.5438328	-13.21283	1519	30mabove ground
11:52:23	-9.54318	-13.21348	1522	90	9.7	-9.5438328	-13.21283	1518	bottom sight
11:52:29	-9.54318	-13.21348	1524	90	7.7	-9.5438328	-13.21283	1519	AT THE BOTTOM
11:52:41	-9.54320	-13.21348	1527	91	5.1	-9.5438328	-13.21283	1522	pillow lava, unsedimented
11:53:31	-9.54322	-13.21352	1527	89	6.6	-9.5438328	-13.21283	1519	unsedimented pillows
11:55:24	-9.54327	-13.21348	1535	141	1.6	-9.5438328	-13.21283	1519	start track with heading 141
11:55:36	-9.54337	-13.21343	1534	140	1.7	-9.5438328	-13.21283	1520	1534,5m wter depth
11:56:26	-9.54343	-13.21337	1535	140	1.8	-9.5438328	-13.21283	1514	HD ON
11:56:31	-9.54343	-13.21340	1535	141	1.7	-9.5438328	-13.21283	1514	pillow lava, unsedimented
11:57:25	-9.54347	-13.21335	1534	140	2.2	-9.5438328	-13.21283	1517	large pillows, some sediment inbetween pilllows
11:57:45	-9.54350	-13.21333	1533	141	2.3	-9.5438328	-13.21283	1527	HD OFF
11:58:37	-9.54353	-13.21328	1531	140	2.8	-9.5438328	-13.21283	1519	pillow lava, unsedimented
12:01:35	-9.54382	-13.21305	1524	141	1.9	-9.5439997	-13.21283	1517	moving up, 1524m, 1,6m above ground
12:02:05	-9.54382	-13.21295	1523	140	1.8	-9.5441666	-13.21283	1520	
12:03:23	-9.54390	-13.21293	1521	141	3.3	-9.5443335	-13.21283	1526	to the left a pile of jumbled lava
12:04:11	-9.54392	-13.21287	1522	101	2.1	-9.5443335	-13.21283	1515	still image
12:04:19	-9.54390	-13.21283	1522	101	2.3	-9.5443335	-13.21283	1529	still image
12:04:31	-9.54392	-13.21283	1522	100	2.3	-9.5445004	-13.21283	1511	2 still images of jumbled lava pile
12:04:49	-9.54388	-13.21283	1520	100	2.7	-9.5445004	-13.21283	1517	shadow in sonar could be a single large lava flow
12:05:09	-9.54392	-13.21282	1520	138	2.5	-9.5445004	-13.21283	1512	HD ON
12:05:47	-9.54387	-13.21282	1521	167	0.7	-9.5445004	-13.21283	1516	a lava stream cracked open at the top, running south-north
12:05:53	-9.54385	-13.21280	1521	167	0.9	-9.5445004	-13.21283	1516	still image
12:05:54	-9.54385	-13.21280	1521	167	0.9	-9.5445004	-13.21283	1516	still image
12:06:01	-9.54385	-13.21280	1521	168	1	-9.5445004	-13.21283	1512	still image
12:06:20	-9.54383	-13.21280	1520	166	2.2	-9.5445004	-13.21283	1517	deep cracks in surface of lava flow
12:06:30	-9.54385	-13.21282	1520	166	2.4	-9.5445004	-13.21283	1518	several still images
12:07:00	-9.54390	-13.21278	1520	166	2.1	-9.5445004	-13.21283	1519	HD OFF
12:07:32	-9.54398	-13.21275	1520	128	1.7	-9.5445004	-13.21283	1508	HD ON
12:07:53	-9.54400	-13.21272	1520	133	1.5	-9.5445004	-13.21283	1519	heading 132
12:08:19	-9.54402	-13.21267	1520	136	1.3	-9.5445004	-13.21283	1517	HD OFF
12:08:59	-9.54410	-13.21262	1520	154	2.4	-9.5445004	-13.21283	1515	single large lava stream ends in pile of jumbled lava
12:09:56	-9.54422	-13.21258	1520	182	2.3	-9.5446672	-13.21283	1523	jumbled lava finished, now pillow lava again, but slightly sedimented
12:10:05	-9.54422	-13.21258	1521	181	2.2	-9.5446672	-13.21283	1528	heading 180 now
12:10:18	-9.54427	-13.21258	1520	177	2.3	-9.5446672	-13.21283	1507	pillows
12:10:26	-9.54430	-13.21257	1520	201	2.3	-9.5446672	-13.21283	1517	heading 190
12:10:35	-9.54430	-13.21257	1521	200	1.8	-9.5446672	-13.21283	1509	still image
12:10:45	-9.54432	-13.21260	1520	199	2.2	-9.5446672	-13.21283	1513	2 still images of pillows
12:10:51	-9.54432	-13.21260	1520	202	1.7	-9.5446672	-13.21283	1513	still image
12:11:02	-9.54433	-13.21260	1519	200	3.1	-9.5446672	-13.21283	1519	HD ON
12:11:41	-9.54438	-13.21262	1516	222	3.1	-9.5446672	-13.21283	1519	1516m
12:11:50	-9.54438	-13.21263	1515	223	2.8	-9.5446672	-13.21283	1517	HD OFF
12:13:29	-9.54458	-13.21278	1513	223	1.4	-9.5446672	-13.21267	1510	now on top of small hill
12:15:21	-9.54482	-13.21295	1523	223	1.3	-9.5446672	-13.21267	1520	still image
12:15:38	-9.54478	-13.21297	1524	222	1.2	-9.5446672	-13.21267	1518	at the foot of another hill with younger pillows
12:15:45	-9.54480	-13.21297	1523	223	2.7	-9.5446672	-13.21267	1518	heading still 226
12:16:16	-9.54485	-13.21300	1518	222	5.9	-9.5446672	-13.21267	1515	smaller elongated pillows
12:16:27	-9.54485	-13.21300	1515	224	8.7	-9.5446672	-13.21267	1515	steep relief up hill
12:16:41	-9.54487	-13.21302	1513	231	8.9	-9.5446672	-13.21267	1520	looks like a wall of pillows
12:16:53	-9.54492	-13.21305	1511	248	11.8	-9.5446672	-13.21267	1525	deep hole behind wall of pillows
12:17:21	-9.54490	-13.21305	1512	354	9.6	-9.5448332	-13.21267	1513	turn vehicle around
12:17:42	-9.54493	-13.21303	1512	33	10.3	-9.5448332	-13.21267	1526	HD ON
12:18:15	-9.54492	-13.21308	1516	30	4	-9.5448332	-13.21267	1522	deep fracture behind wall of pillows, fracture running NE-SW
12:18:59	-9.54493	-13.21298	1515	38	7.4	-9.5448332	-13.21267	1518	7,5m depth at altimeter
12:19:05	-9.54493	-13.21298	1515	32	7	-9.5448332	-13.21267	1518	HD OFF
12:19:49	-9.54502	-13.21303	1515	25	4.8	-9.5450001	-13.21267	1516	wall heading more N-S
12:20:01	-9.54502	-13.21305	1515	359	4.6	-9.5450001	-13.21267	1513	fracture also N-S
12:20:59	-9.54502	-13.21305	1516	255	3.2	-9.545167	-13.21267	1514	wall/pile of pillows W of fracture
12:21:06	-9.54498	-13.21307	1514	271	4.8	-9.545167	-13.21267	1515	HD ON
12:22:43	-9.54495	-13.21308	1509	31	10.2	-9.5453329	-13.21267	1519	HD OFF
12:23:20	-9.54498	-13.21305	1511	161	9.3	-9.5454998	-13.21267	1520	turning south again and continue track, heading 160
12:23:33	-9.54498	-13.21303	1512	166	8.9	-9.5454998	-13.21267	1519	fracture can be seen in sonar
12:24:46	-9.54512	-13.21287	1515	169	7	-9.5454998	-13.21267	1516	heading 180
12:25:40	-9.54538	-13.21278	1518	186	4.9	-9.5454998	-13.21267	1519	pillows, unsedimented
12:26:55	-9.54563	-13.21282	1522	213	1.5	-9.5456667	-13.21267	1520	change track to heading 120
12:28:08	-9.54563	-13.21288	1522	288	2.4	-9.5456667	-13.21267	1515	still waiting
12:28:23	-9.54562	-13.21290	1522	288	2.6	-9.5456667	-13.21267	1513	talus of pillow material
12:28:25	-9.54562	-13.21290	1522	292	3	-9.5456667	-13.21267	1519	still image
12:28:25	-9.54562	-13.21290	1522	292	3	-9.5456667	-13.21267	1519	still image
12:28:40	-9.54565	-13.21292	1522	292	2.6	-9.5456667	-13.21267	1517	2 still images of pillow talus material
12:28:51	-9.54562	-13.21295	1522	292	3.4	-9.5456667	-13.21267	1510	HD ON
12:29:15	-9.54562	-13.21295	1517	292	7.2	-9.5456667	-13.21250	1513	nice cut open pillows
12:29:30	-9.54563	-13.21295	1514	292	10.3	-9.5456667	-13.21267	1509	move up a wall, HD on
12:29:52	-9.54562	-13.21293	1514	278	10.4	-9.5456667	-13.21250	1518	still image
12:30:06	-9.54562	-13.21293	1514	267	10.1	-9.5456667	-13.21250	1517	photo into open pillow

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
12:30:16	-9.54563	-13.21293	1513	267	10.5	-9.5458326	-13.21250	1523	another on
12:30:25	-9.54562	-13.21295	1514	267	10.2	-9.5458326	-13.21250	1511	still image
12:30:31	-9.54562	-13.21295	1514	267	10.2	-9.5458326	-13.21250	1511	still image
12:31:41	-9.54563	-13.21297	1502	277	5.6	-9.5459995	-13.21250	1518	moved up the wall
12:32:17	-9.54565	-13.21303	1502	268	4.7	-9.5459995	-13.21250	1508	small displacement to the W compared to map (we are at the fracture front but the map sees us W)
12:32:35	-9.54563	-13.21308	1502	272	3.1	-9.5459995	-13.21250	1519	move 275 across the front
12:32:36	-9.54563	-13.21308	1502	272	3.1	-9.5459995	-13.21250	1519	HD OFF
12:32:57	-9.54565	-13.21315	1503	281	3.5	-9.5461674	-13.21250	1505	unsedimented pillows
12:33:44	-9.54562	-13.21325	1500	287	1.6	-9.5461674	-13.21250	1510	continue to move W
12:34:26	-9.54563	-13.21338	1502	287	0.7	-9.5463333	-13.21250	1506	pillows, unsedimented
12:34:34	-9.54563	-13.21338	1502	287	1	-9.5463333	-13.21250	1506	topography going done now
12:35:21	-9.54563	-13.21352	1502	287	7.7	-9.5463333	-13.21250	1504	moving another major deep facture
12:36:51	-9.54563	-13.21352	1499	258	10.8	-9.5465002	-13.21250	1513	fracture runs again N-S
12:36:58	-9.54563	-13.21352	1498	245	10.5	-9.5465002	-13.21250	1512	sonar image saved
12:37:21	-9.54565	-13.21350	1497	217	10.2	-9.5465002	-13.21250	1506	fracture zone and wall clearly seen on sonar image (Sonar1)
12:39:46	-9.54563	-13.21343	1497	200	8.9	-9.5465002	-13.21250	1510	looking 192, fracture and both walls on sonar, image saved (Sonar2)
12:40:33	-9.54577	-13.21348	1505	198	5.5	-9.5465002	-13.21250	1501	fracture width appproximately 25 m, but getting narower looking south
12:41:12	-9.54588	-13.21348	1510	199	3.3	-9.5465002	-13.21250	1511	pillow talus
12:42:40	-9.54610	-13.21350	1509	198	3.1	-9.5465002	-13.21250	1499	walls together (Sonar3)
12:43:34	-9.54610	-13.21352	1504	199	6.8	-9.5465002	-13.21250	1505	again steep wall looking South
12:45:12	-9.54628	-13.21335	1500	173	5.6	-9.5465002	-13.21250	1498	moved E then turned S again
12:45:23	-9.54630	-13.21333	1500	170	6.5	-9.5465002	-13.21250	1507	following the wall to south
12:47:27	-9.54642	-13.21318	1497	95	7.4	-9.5465002	-13.21250	1510	moving E to check whether we have a displacement on the map
12:49:34	-9.54635	-13.21288	1511	95	1.4	-9.5466671	-13.21233	1494	moving across steep cliff of pillows
12:51:21	-9.54627	-13.21258	1515	95	3.4	-9.5469999	-13.21233	1498	pillows unsedimented
12:51:41	-9.54623	-13.21255	1512	95	4.3	-9.5469999	-13.21233	1497	again up slope
12:54:06	-9.54625	-13.21238	1506	194	4.7	-9.5473328	-13.21233	1497	we turn towards 190 and continue our track south
12:55:46	-9.54632	-13.21242	1502	191	6	-9.5473328	-13.21233	1510	pillows unsedimented
12:58:49	-9.54682	-13.21237	1507	208	0.7	-9.5473328	-13.21233	1502	turning towards 220
12:59:05	-9.54688	-13.21238	1509	209	1.9	-9.5474997	-13.21233	1500	wall to be seen in sonar
12:59:44	-9.54695	-13.21242	1505	214	6.6	-9.5473328	-13.21233	1499	HD ON
12:59:49	-9.54695	-13.21242	1505	--	--	-9.5473328	-13.21233	1499	moving up the wall
12:59:52	-9.54695	-13.21242	1505	215	6.5	-9.5473328	-13.21233	1499	still image
13:00:59	-9.54702	-13.21248	1496	212	8.9	-9.5473328	-13.21233	1497	HD OFF
13:02:01	-9.54713	-13.21263	1491	246	2.7	-9.5473328	-13.21233	1499	pillows
13:02:41	-9.54715	-13.21267	1488	251	3.6	-9.5473328	-13.21233	1496	1490m
13:03:04	-9.54720	-13.21272	1488	250	7.2	-9.5473328	-13.21233	1491	crossing another N-S running fracture, nicely seen in sonar
13:03:38	-9.54720	-13.21282	1487	268	7.3	-9.5473328	-13.21233	1488	still image
13:04:51	-9.54722	-13.21285	1481	268	10.4	-9.5473328	-13.21233	1504	heading more W
13:06:16	-9.54722	-13.21288	1469	282	20.3	-9.5473328	-13.21233	1500	continue straigth up
13:06:29	-9.54722	-13.21285	1468	273	21.3	-9.5473328	-13.21233	1505	nicely cut open pillow with radial symmetry
13:06:31	-9.54720	-13.21287	1468	273	21.3	-9.5473328	-13.21233	1505	still image
13:06:32	-9.54720	-13.21287	1468	273	21.3	-9.5473328	-13.21233	1505	still image
13:06:39	-9.54720	-13.21285	1468	273	21.7	-9.5473328	-13.21233	1488	2 still images of this
13:08:09	-9.54720	-13.21287	1460	269	26.1	-9.5473328	-13.21233	1487	HD ON
13:08:21	-9.54720	-13.21287	1459	270	8.7	-9.5473328	-13.21233	1493	interesting bio
13:08:26	-9.54722	-13.21288	1459	270	8.7	-9.5473328	-13.21233	1501	still image
13:08:35	-9.54722	-13.21290	1459	--	--	-9.5473328	-13.21233	1501	still image
13:09:12	-9.54723	-13.21283	1453	196	19.5	-9.5473328	-13.21233	1499	HD OFF
13:09:18	-9.54723	-13.21283	1452	185	19.5	-9.5473328	-13.21233	1499	reached the top
13:09:33	-9.54728	-13.21283	1452	182	19.5	-9.5473328	-13.21233	1495	moving 180 south
13:09:56	-9.54732	-13.21283	1451	181	19.5	-9.5473328	-13.21233	1503	following the wall towards south
13:14:20	-9.54818	-13.21270	1478	214	22.3	-9.5476665	-13.21217	1510	still following the wall (on right side)
13:14:42	-9.54825	-13.21268	1482	--	--	-9.5476665	-13.21217	1503	wall composed of pillows, some talus
13:16:25	-9.54840	-13.21255	1481	95	18.3	-9.5478334	-13.21217	1498	turning to the east, moving across towards E, heading 92
13:17:03	-9.54843	-13.21247	1494	134	3.8	-9.5480003	-13.21217	1500	needs to move down, bottom at 1498m
13:17:50	-9.54842	-13.21230	1491	66	9.5	-9.5480003	-13.21217	1496	pillows, unsedimented
13:19:11	-9.54837	-13.21193	1500	135	2.1	-9.5481672	-13.21217	1503	pillows unsedimented
13:19:42	-9.54837	-13.21195	1499	175	3.7	-9.5481672	-13.21217	1498	moving south now again, heading 180
13:21:57	-9.54870	-13.21197	1502	175	1.9	-9.5483332	-13.21217	1502	pillows unsedimented
13:25:02	-9.55243	-13.21078	1498	176	8.8	-9.5483332	-13.21217	1499	pillow lava, fissure ahead, steep slope to the east
13:25:50	-9.54928	-13.21182	1500	161	7.4	-9.5483332	-13.21200	1499	abundant pillow talus, few corals, heading further south
13:29:42	-9.54975	-13.21195	1504	268	8.5	-9.5488329	-13.21200	1511	flying south slong escarpment
13:30:09	-9.54978	-13.21207	1509	268	1.7	-9.5488329	-13.21200	1499	turning to a westerly course, crossing fissure (5m wide)
13:31:37	-9.54980	-13.21227	1507	275	10.4	-9.5489998	-13.21183	1494	still image
13:31:38	-9.54980	-13.21227	1507	275	10.4	-9.5489998	-13.21183	1494	still image
13:31:51	-9.54978	-13.21227	1506	273	10.7	-9.5489998	-13.21183	1503	HD ON
13:31:59	-9.54980	-13.21225	1505	271	12.2	-9.5489998	-13.21183	1499	still image
13:32:05	-9.54980	-13.21225	1504	267	13	-9.5489998	-13.21183	1491	at large wall, climbing up
13:32:34	-9.54978	-13.21230	1501	--	--	-9.5489998	-13.21183	1500	HD OFF
13:34:57	-9.54978	-13.21242	1487	181	3	-9.5493326	-13.21167	1511	many filter feeders
13:35:32	-9.54987	-13.21242	1486	181	5.3	-9.5493326	-13.21167	1507	turning south again, approaching next small hill that appears to be split (on bathymetry)
13:35:59	-9.54993	-13.21238	1483	181	9.5	-9.5493326	-13.21167	1508	hill shows up on sonar
13:36:28	-9.55000	-13.21237	1483	181	6.2	-9.5495005	-13.21167	1511	seems more sedimented, pillow mound
13:36:56	-9.55008	-13.21235	1480	181	4.6	-9.5495005	-13.21167	1508	corals abundaant

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
13:39:24	-9.55027	-13.21247	1472	274	4.6	-9.5498333	-13.21150	1512	lobate flows, approaching the top
13:41:36	-9.55032	-13.21270	1480	219	7.5	-9.5500002	-13.21150	1518	next, much small step down to the east
13:41:47	-9.55032	-13.21272	1479	269	8.9	-9.5500002	-13.21150	1518	the large wall is > 10m in height
13:43:30	-9.55055	-13.21282	1483	194	7.2	-9.5500002	-13.21150	1514	on top of the small hill to the west, change course to south again
13:45:02	-9.55077	-13.21273	1475	137	18.6	-9.5500002	-13.21150	1512	pillows
13:45:34	-9.55077	-13.21267	1492	146	6.1	-9.5500002	-13.21150	1515	turning vehicle SE again, target is the small double mound within the rift axis, ship has to be moved
13:48:09	-9.55092	-13.21223	1486	155	4.3	-9.5500002	-13.21150	1513	back at first step, heading 140°
13:48:30	-9.55092	-13.21223	1483	176	5.8	-9.5500002	-13.21133	1510	at base of mound, lobates, few corals
13:48:51	-9.55093	-13.21222	1479	174	8.2	-9.5501671	-13.21133	1497	HD ON
13:50:00	-9.55105	-13.21223	1470	176	6.6	-9.5501671	-13.21133	1509	HD OFF
13:51:44	-9.55122	-13.21218	1461	188	4.1	-9.550333	-13.21117	1511	broken pillows near top
13:55:52	-9.55097	-13.21178	1505	99	3	-9.5506668	-13.21083	1497	over the top of the large fault, in talus at the bottom (at least 15m below)
13:56:52	-9.55103	-13.21157	1507	119	5	-9.5508327	-13.21083	1498	talus, slightly sedimented
13:57:04	-9.55103	-13.21152	1508	120	2.7	-9.5508327	-13.21083	1500	fissure ahead on sonar
13:57:57	-9.55107	-13.21147	1504	114	4.6	-9.5508327	-13.21083	1496	on small fissure
13:58:30	-9.55105	-13.21138	1507	100	0.4	-9.5508327	-13.21067	1494	HD ON
13:58:41	-9.55105	-13.21135	1507	101	8	-9.5508327	-13.21067	1498	flying over 10m wide fissure
13:59:23	-9.55105	-13.21138	1506	169	10.6	-9.5509996	-13.21067	1496	HD OFF
14:00:30	-9.55105	-13.21133	1501	105	8.6	-9.5509996	-13.21050	1495	fissure exposes massive flows, not piows
14:00:47	-9.55105	-13.21130	1499	106	10.4	-9.5511665	-13.21050	1498	climbing up westfacing wall
14:01:42	-9.55105	-13.21125	1497	105	4	-9.5511665	-13.21050	1485	on top, pilot change, lobate surfaces
14:03:53	-9.55103	-13.21112	1497	109	4.4	-9.5513334	-13.21033	1494	flat pillows, little sediment
14:05:14	-9.55098	-13.21095	1499	112	5	-9.5515003	-13.21017	1501	at small ridge
14:06:36	-9.55102	-13.21078	1497	37	5.9	-9.5515003	-13.21017	1489	large pillows
14:08:19	-9.55110	-13.21067	1494	173	5.7	-9.5516672	-13.21000	1484	it seems tha a strong current is moving us northward, instead of course 125 we make a course of 090 over ground
14:09:19	-9.55127	-13.21048	1494	166	5.7	-9.5518332	-13.21000	1492	large pillows
14:11:10	-9.55135	-13.21040	1492	195	4.6	-9.552	-13.20983	1478	at base of mound, large pillows, less sediment but some corals are pesent, indicating that this mound is not VERY young
14:14:10	-9.55190	-13.21035	1483	184	4.1	-9.552	-13.20983	1497	still image
14:14:44	-9.55197	-13.21035	1482	201	3.6	-9.552	-13.20967	1480	nice pillows, foto shows grey pillows documenting age of the mound
14:16:19	-9.55213	-13.21045	1477	103	5.2	-9.552	-13.20967	1492	at the top of the pillow mound, changing course to 150 in order to visit the second hilltop next to this one
14:16:49	-9.55208	-13.21037	1478	96	5.4	-9.552	-13.20967	1481	pillow lava, unsedimented
14:19:48	-9.55218	-13.20962	1474	144	3.5	-9.552	-13.20967	1483	pillow lava, unsedimented
14:22:20	-9.55243	-13.20938	1466	69	7	-9.552	-13.20967	1487	both mounds are composed of younger,but not recent pillows
14:23:01	-9.55235	-13.20938	1471	59	2.1	-9.552	-13.20967	1481	still image
14:24:42	-9.55222	-13.20922	1474	97	4.9	-9.552	-13.20967	1476	those are small steps going down towards the east
14:25:58	-9.55210	-13.20898	1481	88	3	-9.552	-13.20950	1466	white spots on the pillows
14:28:26	-9.55205	-13.20887	1483	84	5.7	-9.552	-13.20933	1461	more white spots as we approach the fissure (10m wide in sonar)
14:31:25	-9.55183	-13.20880	1491	323	3.3	-9.552	-13.20900	1480	this fissure is splitting the mound
14:31:27	-9.55183	-13.20880	1490	323	3.4	-9.552	-13.20900	1477	still image
14:33:27	-9.55173	-13.20873	1492	14	3.1	-9.552	-13.20867	1490	still image of Fe-oxide staing on pillow
14:36:04	-9.55137	-13.20880	1499	1	3.4	-9.552	-13.20850	1486	fly along NS trending fissure wall
14:37:28	-9.55120	-13.20880	1492	27	5.8	-9.552	-13.20833	1490	large talus pile blocking the northern entrence
14:38:34	-9.55113	-13.20882	1490	67	5.8	-9.5521669	-13.20833	1486	still image
14:38:39	-9.55115	-13.20882	1490	69	4.8	-9.5521669	-13.20833	1492	heading north, smaller fissures crossing our path
14:39:05	-9.55112	-13.20878	1491	70	2.9	-9.5521669	-13.20833	1496	coming into sheet flows, drainback features, foto of a coral large
14:39:11	-9.55112	-13.20878	1491	73	2.8	-9.5521669	-13.20833	1490	still image
14:39:14	-9.55112	-13.20878	1491	73	3	-9.552	-13.20833	1487	HD ON
14:39:47	-9.55113	-13.20877	1490	69	4.8	-9.552	-13.20833	1489	still image
14:40:42	-9.55113	-13.20880	1492	75	1.8	-9.552	-13.20817	1490	still image of large coral
14:40:56	-9.55113	-13.20882	1492	95	2.7	-9.552	-13.20817	1488	HD OFF
14:41:19	-9.55115	-13.20882	1492	96	2.1	-9.552	-13.20817	1488	sheet flowsare gray, not glassy, and show tiny sediment pockets
14:41:33	-9.55103	-13.20877	1492	97	2	-9.552	-13.20817	1490	numerous collapse pits and skylights
14:41:45	-9.55113	-13.20882	1492	102	2.1	-9.552	-13.20817	1490	still image
14:41:47	-9.55113	-13.20882	1492	102	2	-9.552	-13.20817	1492	HD ON
14:42:03	-9.55115	-13.20880	1492	102	2.6	-9.552	-13.20817	1490	still image
14:42:20	-9.55112	-13.20875	1491	102	4	-9.5518332	-13.20817	1488	HD OFF
14:42:58	-9.55110	-13.20877	1492	82	1.6	-9.5518332	-13.20817	1489	HD ON
14:43:15	-9.55112	-13.20875	1492	82	1.7	-9.5518332	-13.20817	1490	still image
14:45:38	-9.55112	-13.20867	1493	353	2.5	-9.5516672	-13.20800	1491	HD OFF
14:46:35	-9.55108	-13.20862	1491	85	3.2	-9.5515003	-13.20800	1493	sonar image No.4 saved showing contact between lava pillars and pillow basalt
14:46:47	-9.55108	-13.20862	1491	88	3	-9.5515003	-13.20800	1495	HD ON
14:47:12	-9.55107	-13.20857	1493	89	1.5	-9.5515003	-13.20800	1492	HD OFF
14:47:56	-9.55113	-13.20862	1490	89	4.6	-9.5515003	-13.20800	1492	still image
14:48:43	-9.55113	-13.20858	1491	96	3.4	-9.5515003	-13.20800	1492	still image
14:49:55	-9.55108	-13.20852	1495	87	1.4	-9.5515003	-13.20800	1492	still image
14:49:57	-9.55108	-13.20852	1495	87	1.5	-9.5515003	-13.20800	1487	HD ON
14:50:24	-9.55098	-13.20845	1494	87	1.4	-9.5515003	-13.20800	1491	pillar is surrounded by sheet flow (another foto)
14:51:17	-9.55095	-13.20838	1493	74	2.1	-9.5515003	-13.20800	1491	metalliferous sediment
14:51:38	-9.55090	-13.20837	1492	83	2.7	-9.5515003	-13.20800	1495	contact between sheet and jumbled flow areas (same flow!)

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
14:52:11	-9.55087	-13.20835	1492	77	2.5	-9.5515003	-13.20800	1492	HD OFF
14:52:30	-9.55090	-13.20837	1493	80	2.3	-9.5515003	-13.20800	1491	small Fe-oxede protrusions
14:52:52	-9.55085	-13.20835	1494	86	1.5	-9.5515003	-13.20800	1491	still image
14:54:09	-9.55088	-13.20822	1493	87	2.2	-9.5513334	-13.20800	1493	into jumbled area with minor Fe-oxides
14:55:49	-9.55083	-13.20810	1492	76	3	-9.5513334	-13.20800	1491	HD ON
14:56:04	-9.55087	-13.20807	1492	76	2.9	-9.5513334	-13.20800	1493	still image
14:56:38	-9.55080	-13.20810	1492	76	3.4	-9.5513334	-13.20800	1497	still image
14:56:42	-9.55080	-13.20810	1491	--	--	-9.5513334	-13.20800	1494	still image
14:57:28	-9.55082	-13.20805	1493	53	1.5	-9.5513334	-13.20800	1490	still image
14:57:45	-9.55080	-13.20800	1493	47	1.9	-9.5513334	-13.20800	1491	HD OFF
14:58:32	-9.55080	-13.20802	1492	1	2.2	-9.5513334	-13.20800	1492	the skylights etc are on a small plateau, flying north now, for 0 m
15:01:34	-9.55055	-13.20827	1492	15	2.2	-9.5516672	-13.20817	0	small fissure, jumbled area with abundant Fe-staining
15:01:38	-9.55050	-13.20825	1492	15	2.2	-9.5516672	-13.20817	0	HD ON
15:02:53	-9.55055	-13.20818	1492	44	2.2	-9.5516672	-13.20817	0	HD OFF
15:04:39	-9.55050	-13.20830	1491	314	2.6	-9.5516672	-13.20817	0	HD OFF
15:04:40	-9.55050	-13.20830	1491	314	2.2	-9.5516672	-13.20817	0	still image
15:04:59	-9.55047	-13.20820	1491	310	2.1	-9.5516672	-13.20817	0	HD ON
15:05:47	-9.55045	-13.20823	1493			-9.5516672	-13.20817	0	still image
15:06:01	-9.55112	-13.21163	1491	315	2.3	-9.5516672	-13.20817	0	HD OFF
15:07:54	-9.55052	-13.20830	1492	267	1.4	-9.5515003	-13.20817	0	leaving thr ruins and flying west towrds the larger fissure
15:08:52	-9.55055	-13.20848	1492	268	2.8	-9.5513334	-13.20817	0	Fe-oxide arrearing
15:09:09	-9.55053	-13.20853	1492	267	2.3	-9.5513334	-13.20817	0	flying over jumbled area with abundant Fe-oxides
15:10:46	-9.55060	-13.20863	1494	244	2	-9.5511665	-13.20817	0	HD ON
15:11:19	-9.55067	-13.20870	1493	261	2.4	-9.5511665	-13.20817	0	HD of this jumbled flow and the Fe-staining
15:11:26	-9.55067	-13.20870	1493	269	2.5	-9.5511665	-13.20817	0	HD OFF
15:12:35	-9.55123	-13.20872	1492	264	2.7	-9.5509996	-13.20817	0	crossing first fissure
15:13:21	-9.55130	-13.21227	1493	263	2.2	-9.5509996	-13.20817	0	fewer Fe-oxides on the other side
15:16:16	-9.55055	-13.20905	1496	13	5.1	-9.5506668	-13.20817	0	Fe-oxide pile at the bottom of the fissure
15:16:20	-9.55055	-13.20905	1496	14	5	-9.5506668	-13.20817	0	still image
15:16:50	-9.55058	-13.20903	1499	7	3.4	-9.5506668	-13.20817	0	HD ON
15:17:03	-9.55057	-13.20907	1499	1	3.4	-9.5506668	-13.20817	0	HD OFF
15:17:06	-9.55057	-13.20907	1499	1	3.1	-9.5506668	-13.20817	0	still image
15:17:12	-9.55058	-13.20907	1500	358	2.9	-9.5504999	-13.20817	0	continue north
15:19:11	-9.55042	-13.20907	1492	339	5.3	-9.550333	-13.20817	0	flying out of the pit
15:20:07	-9.55027	-13.20915	1490	4	3.4	-9.550333	-13.20817	0	continue to the north
15:21:24	-9.55008	-13.20922	1491	2	1.6	-9.550333	-13.20817	0	large pillows
15:21:36	-9.55008	-13.20922	1491	1	1.6	-9.550333	-13.20817	0	small cracks, Fe-staining appears again
15:22:02	-9.55012	-13.20920	1491	353	1.9	-9.550333	-13.20817	0	still image
15:23:22	-9.54993	-13.20928	1491	360	1.4	-9.550333	-13.20817	0	pillow lava, unsedimented
15:26:23	-9.54965	-13.20932	1495	352	2.4	-9.5500002	-13.20817	0	flew inside a small pit, Fe-oxides at the bottom (less than before), fissure is continues to the north
15:29:51	-9.54933	-13.20933	1493	3	6.1	-9.5496674	-13.20817	0	sonare image no 5 saved; fissure trending north
15:31:54	-9.54905	-13.20945	1493	360	3	-9.5495005	-13.20833	0	pillow lava, unsedimented
15:31:56	-9.54905	-13.20945	1493	359	3.2	-9.5495005	-13.20833	0	pillow lava, unsedimented
15:33:30	-9.54892	-13.20945	1493	92	1.9	-9.5495005	-13.20833	0	turning east to see if the drainback features reach so far north
15:33:45	-9.54888	-13.20940	1493	92	2.3	-9.5495005	-13.20833	0	HD ON
15:34:28	-9.54888	-13.20928	1492	92	1.6	-9.5495005	-13.20833	0	HD OFF
15:34:31	-9.54888	-13.20928	1493	92	1.7	-9.5493326	-13.20833	0	flying over lobate flows turning into pillow lava
15:35:46	-9.54882	-13.20907	1491	95	2.3	-9.5495005	-13.20833	0	few corals
15:37:36	-9.54880	-13.20895	1490	92	2	-9.5495005	-13.20833	0	pilot change
15:39:36	-9.54865	-13.20905	1490	1	2.4	-9.5493326	-13.20833	0	heading north over pilow lava for 30m before heading west again
15:43:57	-9.54827	-13.20965	1491	4	5.9	0	0.00000	123	flying over pillows, but within fissured area
15:46:25	-9.54793	-13.20972	1496	19	4.6	0	0.00000	122	white patches, mussel shells
15:49:10	-9.54758	-13.20978	1498	72	3.7	0	0.00000	121	have to turn 70° in order to get to the target (Main Lilliput site) in time
15:49:49	-9.54750	-13.20965	1494	85	2.6	0	0.00000	123	pillow lava, unsedimented
15:54:23	-9.54730	-13.20920	1493	66	1	0	0.00000	123	marker MA in sight
15:54:45	-9.54732	-13.20922	1493	66	0.6	0	0.00000	123	HD ON
15:55:28	-9.54733	-13.20920	1492	66	1.7	0	0.00000	123	SIX MINUTES BEFORE THE TIME IS UP MIRJAM !!!
15:59:51	-9.54740	-13.20912	1490	304	3.6	0	0.00000	123	searching for the site for tidal experiment
16:07:49	-9.54735	-13.20915	1493	309	0.9	0	0.00000	123	positioned ourselves at the site at lilliput
16:10:46	-9.54733	-13.20912	1493	309	0.8	0	0.00000	123	positioning nozzle into whole
16:12:05	-9.54738	-13.20913	1493	310	0.8	0	0.00000	123	smoni moved a little
16:12:48	-9.54727	-13.20923	1493	309	0.8	0	0.00000	123	still image
16:14:22	-9.54737	-13.20912	1493	309	0.8	0	0.00000	123	KIPS ON
16:15:32	-9.54737	-13.20917	1493	310	0.8	0	0.00000	123	KIPS OFF
16:15:33	-9.54737	-13.20917	1493	310	0.8	0	0.00000	123	KIPS ON
16:15:34	-9.54737	-13.20917	1493	310	0.8	0	0.00000	123	**325 ROV 1 (kips A2)**
16:15:50	-9.54737	-13.20915	1493	310	0.8	0	0.00000	123	KIPS OFF
16:16:17	-9.54737	-13.20915	1493	309	0.8	0	0.00000	123	KIPS ON
16:21:27	-9.54740	-13.20915	1493	309	0.7	0	0.00000	123	HD ON
16:21:38	-9.54742	-13.20913	1493	309	0.7	0	0.00000	123	HD OFF
16:22:19	-9.54740	-13.20915	1493	309	0.8	0	0.00000	123	HD ON
16:23:17	-9.54737	-13.20912	1493	310	0.7	0	0.00000	123	HD OFF
16:23:25	-9.54738	-13.20912	1493	309	0.7	0	0.00000	123	KIPS OFF
16:23:26	-9.54738	-13.20912	1493	309	0.7	0	0.00000	123	KIPS OFF
16:23:40	-9.54738	-13.20910	1493	310	0.7	0	0.00000	123	KIPS ON
16:23:41	-9.54738	-13.20910	1493	309	0.7	0	0.00000	123	**325 ROV 2 (KIPS A3)**
16:30:03	-9.54738	-13.20913	1493	311	0.8	0	0.00000	123	KIPS OFF

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
16:30:24	-9.54738	-13.20913	1493	310	0.7	0	0.00000	123	KIPS ON
16:30:25	-9.54738	-13.20913	1493	311	0.7	0	0.00000	123	**325 ROV 3 (KIPS B4)**
16:37:08	-9.54737	-13.20913	1493	309	0.7	0	0.00000	123	KIPS OFF
16:37:28	-9.54740	-13.20912	1493	309	0.7	0	0.00000	123	KIPS ON
16:37:29	-9.54740	-13.20912	1493	309	0.7	0	0.00000	123	**325 ROV 4 (KIPS B5)**
16:44:04	-9.54742	-13.20912	1493	309	0.8	-9.5485001	-13.20833	0	KIPS OFF
16:44:30	-9.54740	-13.20913	1493	310	0.8	-9.5485001	-13.20833	0	KIPS ON
16:44:30	-9.54740	-13.20913	1493	310	0.8	-9.5485001	-13.20833	0	**325 ROV 5 (KIPS B6)**
16:45:04	-9.54737	-13.20912	1493	310	0.8	-9.5485001	-13.20833	0	8.9°C temperature
16:49:05	-9.54735	-13.20913	1493	309	0.8	-9.5485001	-13.20833	0	still image
16:49:21	-9.54737	-13.20912	1493	309	0.8	-9.5485001	-13.20833	0	still image
16:51:42	-9.54733	-13.20915	1493	309	0.8	-9.5485001	-13.20833	0	KIPS OFF
16:52:35	-9.54737	-13.20913	1493	309	0.8	-9.5485001	-13.20850	0	KIPS ON
16:52:36	-9.54737	-13.20913	1493	309	0.8	-9.5485001	-13.20850	0	**325 ROV 6 (KIPS C7)**
17:00:28	-9.54737	-13.20912	1493	309	0.8	-9.5485001	-13.20833	0	KIPS OFF
17:00:49	-9.54738	-13.20913	1493	309	0.8	-9.5485001	-13.20833	0	KIPS ON
17:00:49	-9.54738	-13.20913	1493	309	0.8	-9.5485001	-13.20833	0	**325 ROV 7 (KIPS C8)**
17:07:19	-9.54737	-13.20913	1493	309	0.8	-9.5485001	-13.20850	0	KIPS OFF
17:07:32	-9.54730	-13.20910	1493	309	0.8	-9.5485001	-13.20850	0	KIPS ON
17:07:34	-9.54730	-13.20910	1493	309	0.8	-9.5485001	-13.20850	0	**325 ROV 8 (KIPS C9)**
17:14:43	-9.54737	-13.20912	1493	309	0.8	-9.5485001	-13.20850	0	KIPS OFF
17:15:23	-9.54737	-13.20912	1493	309	0.8	-9.5485001	-13.20833	0	KIPS ON
17:15:38	-9.54738	-13.20912	1493	309	0.8	-9.5485001	-13.20850	0	**325 ROV 9 (KIPS A1)**
17:22:37	-9.54735	-13.20913	1493	310	0.8	-9.5485001	-13.20850	0	KIPS OFF
17:22:46	-9.54737	-13.20913	1493	309	0.8	-9.5485001	-13.20833	0	dosierpumpe
17:24:16	-9.54738	-13.20910	1493	310	0.7	-9.5485001	-13.20833	0	dosierpumpe off
17:31:26	-9.54742	-13.20913	1493	310	0.8	-9.5483332	-13.20833	0	search for larger mussels
17:35:45	-9.54737	-13.20917	1493	309	0.8	-9.5478334	-13.20833	0	grabbing net and opening box with net
17:39:13	-9.54735	-13.20913	1491	305	2.9	-9.5478334	-13.20850	0	lift off to search for larger mussels
17:42:13	-9.54730	-13.20918	1493	266	0.5	-9.5478334	-13.20850	0	mussel patches, whitish
17:42:51	-9.54728	-13.20918	1493	261	0.2	-9.5478334	-13.20850	0	found somewhat larger mussels
17:43:20	-9.54725	-13.20918	1493	262	0.2	-9.5478334	-13.20850	0	**sample 325 ROV10**
17:43:35	-9.54730	-13.20918	1493	261	0.2	-9.5478334	-13.20833	0	getting mussel sample
17:45:27	-9.54725	-13.20918	1493	261	0.5	-9.5478334	-13.20833	0	further looking for larger mussels without changing net
17:46:41	-9.54728	-13.20902	1491	217	2.1	-9.5478334	-13.20850	0	net was about 5 m away from SMONI
17:48:13	-9.54727	-13.20913	1492	187	1.5	-9.5478334	-13.20833	0	pillow lava with mussel patches
17:49:26	-9.54602	-13.20947	1494	174	0.6	-9.5478334	-13.20850	0	Hydroids
17:51:46	-9.54727	-13.20917	1494	176	0.6	-9.5478334	-13.20833	0	found larger mussels, aggregates of larger individuals and many small individuals
17:52:14	-9.54727	-13.20920	1494	176	0.6	-9.5478334	-13.20833	0	taking more mussels with net
17:54:48	-9.54727	-13.20915	1494	175	0.7	-9.5478334	-13.20850	0	getting mussels with net, scratching off pillow
17:56:53	-9.54725	-13.20917	1494	166	0.7	-9.5478334	-13.20850	0	scratching mussels from pillow lava
17:59:48	-9.54727	-13.20917	1494	--	--	-9.5478334	-13.20833	0	scratching mussels with net#
18:01:33	-9.54728	-13.20913	1493	165	0.7	-9.5478334	-13.20833	0	HD ON
18:01:35	-9.54727	-13.20912	1493	165	0.7	-9.5478334	-13.20833	0	transfering net to box
18:01:55	-9.54727	-13.20913	1493	163	0.7	-9.5478334	-13.20833	0	sample STOP
18:02:09	-9.54725	-13.20913	1493	163	0.7	-9.5478334	-13.20833	0	HD OFF
18:03:00	-9.54725	-13.20913	1493	164	0.7	-9.5478334	-13.20833	0	closing grey box
18:04:35	-9.54723	-13.20913	1493	170	0.9	-9.5478334	-13.20833	0	lift off
18:05:16	-9.54720	-13.20912	1489	343	4.9	-9.5478334	-13.20833	0	lift off, flying high towards Candelabrum Meadows
18:06:34	-9.54702	-13.20908	1488	11	4.8	-9.5478334	-13.20833	0	flying 5 m over ground
18:06:39	-9.54702	-13.20908	1488	11	4.9	-9.5478334	-13.20833	0	pillows with Fe-oxides
18:06:52	-9.54688	-13.20908	1488	12	4.9	-9.5478334	-13.20833	0	intense Fe-oxide cover
18:07:53	-9.54663	-13.20910	1490	18	4.9	-9.5478334	-13.20833	0	small fissure NS trending
18:09:22	-9.54633	-13.20902	1492	23	4.8	-9.5476665	-13.20833	0	Fe-oxide chimney
18:12:09	-9.54600	-13.20903	1490	23	4.1	-9.5473328	-13.20833	0	large Fe-oxide chimneys
18:12:29	-9.54597	-13.20902	1491	22	4.3	-9.5473328	-13.20833	0	back in pillow lava with minor Fe-oxides
18:12:46	-9.54592	-13.20903	1491	24	4.1	-9.5473328	-13.20833	0	lobate flows to pillows,Fe-oxides disappeared
18:15:02	-9.54537	-13.20895	1487	26	4.8	-9.5469999	-13.20833	0	patchy Fe-oxides in interstices
18:17:35	-9.54502	-13.20892	1488	33	5.1	-9.5466671	-13.20817	0	waiting for the ship to catch up
18:18:20	-9.54488	-13.20885	1489	33	5	-9.5465002	-13.20817	0	mussel patches ahead, few Fe-oxides
18:21:07	-9.54482	-13.20882	1493	33	2	-9.5461674	-13.20817	0	HD ON
18:23:16	-9.54467	-13.20883	1493	52	2	-9.5456667	-13.20800	0	HD OFF
18:23:36	-9.54465	-13.20880	1493	53	1.9	-9.5454998	-13.20800	0	still image
18:23:39	-9.54465	-13.20880	1492	53	2	-9.5454998	-13.20800	0	empty shells and abundant tiny mussels
18:24:13	-9.54470	-13.20890	1493	53	2	-9.5454998	-13.20800	0	HD ON
18:24:16	-9.54470	-13.20890	1493	53	2	-9.5454998	-13.20800	0	baby mussels everywhere
18:25:15	-9.54458	-13.20878	1491	62	2.1	-9.545167	-13.20800	0	HD OFF
18:26:28	-9.54437	-13.20867	1493	50	2.4	-9.5450001	-13.20783	0	back in pillow lava
18:27:23	-9.54425	-13.20860	1495	47	2.6	-9.5448332	-13.20783	0	Fe-oxides
18:28:48	-9.54410	-13.20848	1498	47	3	-9.5446672	-13.20783	0	Fe4-oxides covering larger areas
18:28:56	-9.54410	-13.20847	1499	--	--	-9.5446672	-13.20783	0	pillows
18:29:52	-9.54397	-13.20840	1502	46	4	-9.5446672	-13.20783	0	pillow lava, unsedimented
18:30:01	-9.54395	-13.20838	1500	45	5.5	-9.5445004	-13.20783	0	fish
18:31:35	-9.54370	-13.20840	1503	18	6	-9.5445004	-13.20783	0	pillow lava, unsedimented
18:32:47	-9.54355	-13.20845	1508	18	2.5	-9.5445004	-13.20783	0	jumbled lava
18:33:42	-9.54350	-13.20847	1510	18	1.7	-9.5443335	-13.20783	0	white patches ahead
18:36:03	-9.54337	-13.20838	1509	33	2.5	-9.5443335	-13.20783	0	jumbled lava
18:37:20	-9.54335	-13.20845	1509	272	2.6	-9.5443335	-13.20783	0	contact jumbled lava to lobate flows with skylights
18:37:32	-9.54335	-13.20845	1508	272	2.7	-9.5443335	-13.20783	0	turning west in order to find Candelabrum Meadows
18:39:53	-9.54320	-13.20868	1506	73	3.1	-9.5441666	-13.20767	0	pillows and lobate lava
18:41:03	-9.54322	-13.20865	1506	66	3	-9.5441666	-13.20767	0	after 22m north continuing north
18:41:54	-9.54308	-13.20873	1505	2	2.8	-9.5439997	-13.20767	0	pillows

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
18:43:02	-9.54298	-13.20878	1503	1	3.1	-9.5439997	-13.20767	0	now having moved 30m north but actually NW due to SE current
18:44:37	-9.54297	-13.20880	1503	357	3.2	-9.5438328	-13.20767	0	some lobate lava flows
18:45:17	-9.54290	-13.20883	1501	354	3.4	-9.5438328	-13.20767	0	lobate lava
18:46:32	-9.54260	-13.20905	1501	354	3.1	-9.5438328	-13.20767	0	larger lobate flows
18:48:43	-9.54227	-13.20932	1499	337	3.3	-9.5436668	-13.20783	0	contact lobate flow talus material
18:48:56	-9.54225	-13.20935	1499	338	3.4	-9.5436668	-13.20783	0	hill ahead
18:49:23	-9.54223	-13.20940	1498	338	3.2	-9.5436668	-13.20783	0	HD ON
18:49:32	-9.54227	-13.20940	1499	350	3.6	-9.5436668	-13.20783	0	fractures in small hill in different directions
18:49:43	-9.54227	-13.20940	1498	354	3.6	-9.5436668	-13.20783	0	now fracture N-S, HD on
18:50:30	-9.54222	-13.20947	1493	345	5.8	-9.5434999	-13.20783	0	steep walls and deep fracture
18:50:32	-9.54220	-13.20945	1493	345	6.1	-9.5434999	-13.20783	0	HD OFF
18:51:21	-9.54225	-13.20948	1494	343	4	-9.5433331	-13.20800	0	still image
18:51:52	-9.54223	-13.20947	1495	344	3.4	-9.5433331	-13.20800	0	still image
18:52:03	-9.54223	-13.20945	1495	344	3.4	-9.5433331	-13.20800	0	several still images of fracture
18:53:46	-9.54222	-13.20947	1493	3	3.9	-9.5430002	-13.20817	0	still image
18:54:19	-9.54222	-13.20948	1493	9	5.3	-9.5428333	-13.20833	0	still image of northern wall, fracture turning to the NW now
18:55:02	-9.54220	-13.20948	1491	331	5.9	-9.5426674	-13.20833	0	moving NW along fracture
18:56:26	-9.54217	-13.20957	1494	326	3.9	-9.5426674	-13.20833	0	still image
18:56:55	-9.54218	-13.20960	1494	341	3.9	-9.5426674	-13.20833	0	still image
18:57:26	-9.54215	-13.20967	1495	344	4.3	-9.5424995	-13.20833	0	fracature is slowly closing/tapering out
18:58:58	-9.54195	-13.20985	1502	347	2.6	-9.5424995	-13.20850	0	pillows
19:06:50	-9.54167	-13.21058	1498	319	7.9	-9.5419998	-13.20917	0	pillows with brownish hydrothermal sediment
19:07:06	-9.54165	-13.21062	1496	319	6.4	-9.5419998	-13.20917	0	now clean pillows
19:07:12	-9.54165	-13.21062	1496	320	5.5	-9.5419998	-13.20917	0	relief going up
19:07:28	-9.54163	-13.21068	1494	314	3.5	-9.5419998	-13.20917	0	HD ON
19:08:38	-9.54157	-13.21075	1489	317	4.3	-9.5418329	-13.20933	0	HD OFF
19:08:52	-9.54155	-13.21080	1488	316	3.7	-9.5418329	-13.20933	0	Fe rich crusts
19:09:01	-9.54152	-13.21078	1488	316	3.6	-9.5418329	-13.20950	0	HD ON
19:09:07	-9.54153	-13.21077	1487	316	4.1	-9.5418329	-13.20950	0	still image
19:09:22	-9.54152	-13.21078	1487	316	4.4	-9.5418329	-13.20950	0	looks like thick crust of Fe rich material
19:09:47	-9.54152	-13.21078	1487	316	4.9	-9.5418329	-13.20950	0	still image
19:09:48	-9.54152	-13.21078	1487	316	4.9	-9.5418329	-13.20950	0	HD OFF
19:17:43	-9.54153	-13.21082	1488	316	3.1	-9.5410004	-13.21067	0	HD ON
19:18:16	-9.54155	-13.21083	1486	316	3.3	-9.5410004	-13.21067	0	HD OFF
19:19:36	-9.54145	-13.21097	1486	316	1.6	-9.5410004	-13.21067	0	continue track towards NW, pillows
19:21:20	-9.54137	-13.21115	1486	318	1.4	-9.5408335	-13.21100	0	beautiful pillows
19:22:19	-9.54125	-13.21133	1487	325	1.7	-9.5406666	-13.21100	0	more lobate flows
19:25:37	-9.54112	-13.21153	1488	325	0.9	-9.5404997	-13.21150	0	HD ON
19:25:39	-9.54112	-13.21153	1488	326	0.9	-9.5404997	-13.21150	0	HD OFF
19:25:52	-9.54113	-13.21153	1488	326	1	-9.5403328	-13.21150	0	HD image of purple bio
19:26:43	-9.54108	-13.21158	1487	324	2	-9.5403328	-13.21167	0	pillows and lobate flows
19:29:35	-9.54087	-13.21192	1485	325	1.2	-9.5401669	-13.21183	0	HD ON
19:30:34	-9.54080	-13.21200	1485	325	1.3	-9.5401669	-13.21183	0	HD OFF
19:30:59	-9.54082	-13.21200	1485	325	1.2	-9.5401669	-13.21183	0	still image
19:30:59	-9.54082	-13.21200	1485	325	1.2	-9.5401669	-13.21183	0	still image
19:31:13	-9.54082	-13.21200	1485	324	1.2	-9.5401669	-13.21183	0	several still images of coral
19:31:30	-9.54083	-13.21202	1485	324	1.5	-9.5401669	-13.21183	0	HD ON
19:31:48	-9.54082	-13.21202	1485	325	1.6	-9.5401669	-13.21183	0	HD OFF
19:32:54	-9.54073	-13.21213	1487	331	1.1	-9.5401669	-13.21183	0	lobate flows
19:33:52	-9.54063	-13.21228	1487	331	1.5	-9.5401669	-13.21183	0	still heading 330
19:35:34	-9.54048	-13.21262	1493	335	2.1	-9.5401669	-13.21183	0	slope to the right, i.e. north
19:35:49	-9.54045	-13.21267	1492	5	2.6	-9.5401669	-13.21183	0	change course to N
19:36:34	-9.54032	-13.21285	1493	4	1.8	-9.5401669	-13.21183	0	moving alongside slope
19:38:04	-9.54000	-13.21298	1507	360	3.4	-9.5401669	-13.21183	0	lobate flows
19:43:48	-9.53975	-13.21300	1515	--	--	-9.5401669	-13.21183	0	turning to 320
19:45:24	-9.53958	-13.21313	1519	323	4	-9.5401669	-13.21183	0	more pillows, some lobate flows
19:54:33	-9.53927	-13.21388	1493	265	6.6	-9.5391674	-13.21267	0	continue with lobate flows and pillows
19:56:29	-9.53928	-13.21413	1488	286	7.6	-9.5389996	-13.21283	0	OFF THE BOTTOM
20:50:55	0.00000	0.00000	11	--	--	-9.5398331	-13.21500	0	ON DECK

Cruise: MAR SOUTH V
Date: 01.05.2009
Station: M78-2_329ROV
Targets: Lilliput

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
09:42:52	0.00000	0.00000	0	--	--	-9.541667	-13.20967	1501	IN THE WATER
10:46:24	-9.54725	-13.20935	1490	107	5.2	-9.5475	-13.20867	0	AT THE BOTTOM
10:50:27	-9.54728	-13.20910	1488	325	5.0	-9.5474997	-13.20867	0	looking for lilliput
10:53:50	-9.54747	-13.20917	1490	293	4.7	-9.54750	-13.20867	0	seeing SMoni
10:55:51	-9.54750	-13.20917	1494	290	0.8	-9.5474997	-13.20867	0	positioning ROC for sample collection
11:05:31	-9.54750	-13.20918	1494	284	0.4	-9.5474997	-13.20867	0	positioning ROV
11:08:15	-9.54750	-13.20918	1494	287	0.6	-9.5474997	-13.20867	0	checking whether arm reaches
11:09:12	-9.54752	-13.20918	1494	287	0.6	-9.5474997	-13.20867	0	grabbing nozzle of kips
11:17:18	-9.54750	-13.20917	1494	288	0.6	-9.5474997	-13.20867	0	KIPS ON
11:17:54	-9.54748	-13.20913	1494	288	0.6	-9.5474997	-13.20867	0	**329 ROV 1 (KIPS C7)**
11:24:35	-9.54747	-13.20920	1494	288	0.6	-9.5474997	-13.20867	0	KIPS OFF
11:24:49	-9.54748	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	KIPS ON
11:24:49	-9.54748	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	**329 ROV 2 (KIPS C8)**
11:26:11	-9.54747	-13.20920	1494	288	0.6	-9.5474997	-13.20867	0	still image
11:31:21	-9.54745	-13.20915	1494	288	0.6	-9.5474997	-13.20867	0	KIPS OFF
11:31:35	-9.54748	-13.20917	1494	288	0.6	-9.5474997	-13.20867	0	KIPS ON
11:31:35	-9.54748	-13.20917	1494	288	0.6	-9.5474997	-13.20867	0	**329 ROV 3 (KIPS C9)**
11:37:25	-9.54750	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	still image
11:38:33	-9.54753	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	KIPS OFF
11:39:38	-9.54752	-13.20920	1494	288	0.6	-9.5474997	-13.20867	0	kips back into porch
11:41:49	-9.54750	-13.20918	1494	287	0.6	-9.5474997	-13.20867	0	collect SMoni from diffuse position where temperature was logged for three days
11:42:37	-9.54750	-13.20920	1494	287	0.6	-9.5474997	-13.20867	0	grabbed SMoni
11:48:47	-9.54748	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	put SMoni into draw of porch
11:52:28	-9.54752	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	placing SMoni into draw of rov
11:58:43	-9.54748	-13.20920	1494	--	--	-9.5474997	-13.20867	0	putting marker a down at this spot; marker number 42
12:02:01	-9.54752	-13.20917	1494	288	0.6	-9.5474997	-13.20867	0	placing marker 42
12:03:51	-9.54752	-13.20922	1494	289	0.6	-9.5474997	-13.20867	0	storing SMoni into back of drawer
12:14:00	-9.54748	-13.20920	1494	287	0.6	-9.5474997	-13.20867	0	storing done
12:14:14	-9.54750	-13.20920	1494	287	0.6	-9.5474997	-13.20867	0	opening grey box
12:15:55	-9.54750	-13.20918	1494	288	0.6	-9.5474997	-13.20867	0	box open
12:17:36	-9.54750	-13.20917	1494	288	0.6	-9.5474997	-13.20867	0	getting scoop net
12:18:19	-9.54748	-13.20918	1494	287	0.6	-9.5474997	-13.20867	0	getting up, searching large mussels
12:25:41	-9.54713	-13.20820	1494	284	0.3	-9.5474997	-13.20867	0	in position for sampling
12:28:55	-9.54743	-13.20928	1493	290	1.1	-9.5474997	-13.20867	0	new search
12:39:29	-9.54740	-13.20938	1492	219	3.6	-9.5474997	-13.20867	0	stowing away empty net, no success
12:52:01	-9.54735	-13.20940	1477	38	18.1	-9.5474997	-13.20867	0	lift off, heading 030 for the next 3 km!!
12:54:46	-9.54692	-13.20935	1402	32	33.8	-9.5473328	-13.20850	0	relocating to area of intense Eh anomaly (coordinates are: 09°31.45`S / 13°11.82`W)
12:55:07	-9.54690	-13.20937	1405	38	33.8	-9.5473328	-13.20850	0	ROV comes up to 1400m
13:26:31	-9.54290	-13.20750	1405	64	33.8	-9.5426674	-13.20583	0	a small step for the ROV (on the map!)
13:46:37	-9.54070	-13.20555	1404	63	33.8	-9.5408335	-13.20483	0	1.6 km away from target position; AUV is ahead, but should be well north of us when we arrive
14:11:58	-9.53800	-13.20340	1399	69	33.8	-9.5384998	-13.20267	0	1.2 km to go
14:59:10	-9.53258	-13.19845	1494	62	33.8	-9.5334997	-13.19833	0	heading to 09°31.65, 13°1176,coming from main Lilliput
14:59:22	-9.53252	-13.19842	1497	62	33.8	-9.5334997	-13.19833	0	slowly going down
15:09:16	-9.53165	-13.19795	1594	24	18.4	-9.5319996	-13.19733	0	bottom in sihgt
15:11:23	-9.53123	-13.19793	1603	--	--	-9.5316668	-13.19700	0	lobate flow, < 50 % sediment
15:16:10	-9.53075	-13.19782	1631	25	6.0	-9.531167	-13.19667	0	lobate flow, < 50 % sediment
15:19:53	-9.53045	-13.19783	1648	9	4.3	-9.531167	-13.19650	0	changing heading to 8°
15:19:57	-9.53043	-13.19783	1648	9	4.4	-9.531167	-13.19650	0	pillow lava, > 50% sediment
15:20:13	-9.53040	-13.19782	1649	16	4.4	-9.531167	-13.19650	0	lobate flow, > 50 % sediment
15:23:07	-9.53012	-13.19788	1655	16	4.4	-9.531167	-13.19650	0	lobate flow, > 50 % sediment
15:25:50	-9.52990	-13.19788	1656	16	4.3	-9.531167	-13.19650	0	pillow lava, > 50% sediment
15:27:46	-9.52973	-13.19787	1655	10	4.1	-9.5310001	-13.19650	0	lobate flow, > 50 % sediment
15:28:23	-9.52968	-13.19788	1654	9	4.3	-9.5310001	-13.19650	0	sediment with ripple marks
15:28:28	-9.52968	-13.19788	1654	9	4.3	-9.5310001	-13.19650	0	lobate flow, > 50 % sediment
15:32:38	-9.52945	-13.19780	1653	9	4.3	-9.5306673	-13.19633	0	still image
15:34:29	-9.52940	-13.19777	1651	10	4.2	-9.5303326	-13.19633	0	lobate flow, > 50 % sediment
15:36:58	-9.52918	-13.19780	1649	7	4.2	-9.5299997	-13.19617	0	lobate flow, > 50 % sediment
15:39:18	-9.52902	-13.19782	1652	8	4.4	-9.5295	-13.19600	0	sediment
15:40:56	-9.52893	-13.19780	1651	7	4.3	-9.5291672	-13.19600	0	sediment
15:43:51	-9.52870	-13.19782	1650	7	4.4	-9.5288334	-13.19600	0	piles of pillows inbetween thick sediments
15:48:25	-9.52807	-13.19775	1647	10	2.6	-9.5279999	-13.19600	0	still image
15:48:40	-9.52802	-13.19777	1647	10	2.6	-9.5279999	-13.19600	0	still image
15:49:07	-9.52800	-13.19778	1647	9	2.9	-9.5279999	-13.19600	0	still images of pillows in sediments
15:51:09	-9.52765	-13.19780	1646	349	3.4	-9.527667	-13.19600	0	wide plain covered in sediment
15:52:50	-9.52743	-13.19782	1647	4	2.8	-9.5273333	-13.19600	0	still image
15:53:05	-9.52748	-13.19782	1646	4	3.0	-9.5273333	-13.19600	0	image of contact between coarse and fine sediment
15:54:55	-9.52710	-13.19787	1641	354	3.7	-9.5271673	-13.19600	0	moving up a little slope, some more pillows cropping out
15:56:07	-9.52688	-13.19790	1641	359	3.5	-9.5271673	-13.19600	0	slope/hill in front, pillows, moving up
15:56:44	-9.52680	-13.19792	1637	3	6.0	-9.5271673	-13.19600	0	lava flows
15:56:54	-9.52675	-13.19793	1636	2	5.8	-9.5271673	-13.19600	0	thick lava wall
15:57:08	-9.52677	-13.19792	1638	1	1.7	-9.5271673	-13.19600	0	still image
15:57:09	-9.52677	-13.19792	1638	1	1.7	-9.5271673	-13.19600	0	still image
15:57:09	-9.52677	-13.19792	1638	1	1.7	-9.5271673	-13.19600	0	still image
15:57:29	-9.52675	-13.19790	1639	4	2.4	-9.5271673	-13.19600	0	several stil images of lava flow and lava wall with banding

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
15:58:29	-9.52658	-13.19793	1637	10	5.0	-9.5271673	-13.19600	0	another sedimen covered plain ahead
15:59:00	-9.52657	-13.19792	1641	4	4.7	-9.5271673	-13.19600	0	again, darker coarse material and lighter fine material
16:00:17	-9.52640	-13.19797	1643	1	3.6	-9.5271673	-13.19600	0	
16:05:56	-9.52575	-13.19803	1645	341	2.4	-9.5263329	-13.19600	0	sediment, few pillows cropping out inbetween
16:08:39	-9.52555	-13.19813	1646	342	2.8	-9.526	-13.19600	0	HD ON
16:08:56	-9.52555	-13.19817	1647	342	2.6	-9.526	-13.19600	0	HD: sediment with few pillows
16:09:14	-9.52555	-13.19820	1646	341	2.5	-9.526	-13.19600	0	HD OFF
16:12:52	-9.52520	-13.19835	1646	342	2.9	-9.5255003	-13.19600	0	arriving at the wall
16:13:06	-9.52517	-13.19833	1646	341	3.0	-9.5255003	-13.19600	0	moving up, just afew meters
16:15:04	-9.52493	-13.19833	1645	358	3.0	-9.5251675	-13.19600	0	HD ON
16:15:59	-9.52480	-13.19833	1643	358	4.1	-9.5249996	-13.19600	0	HD OFF
16:17:27	-9.52465	-13.19835	1642	357	4.4	-9.5248327	-13.19600	0	still image
16:17:36	-9.52467	-13.19837	1641	357	4.9	-9.5248327	-13.19600	0	nice pillow in sediment
16:18:41	-9.52460	-13.19833	1639	2	5.4	-9.5246668	-13.19617	0	at the slope: pillow and talues
16:19:27	-9.52458	-13.19835	1636	1	5.7	-9.5244999	-13.19617	0	still image
16:19:36	-9.52458	-13.19835	1636	2	5.5	-9.5244999	-13.19617	0	HD ON
16:19:51	-9.52455	-13.19837	1635	2	5.5	-9.5244999	-13.19617	0	still image of cut-open pillow
16:20:02	-9.52455	-13.19838	1633	359	5.8	-9.5244999	-13.19617	0	HD OFF
16:23:02	-9.52437	-13.19852	1625	343	2.2	-9.5241671	-13.19617	0	still moving up slope, quite some sediment, but also nice pillows
16:24:22	-9.52420	-13.19862	1622	349	3.0	-9.5240002	-13.19617	0	HD ON
16:25:18	-9.52417	-13.19873	1620	338	3.0	-9.5238333	-13.19617	0	HD OFF
16:27:34	-9.52405	-13.19892	1614	41	3.5	-9.5236673	-13.19617	0	moving up another slope with talus, darker rocks
16:27:50	-9.52410	-13.19888	1612	--	--	-9.5236673	-13.19617	0	still image
16:29:14	-9.52400	-13.19880	1610	52	1.9	-9.5236673	-13.19633	0	HD ON
16:29:22	-9.52398	-13.19878	1610	55	1.7	-9.5238333	-13.19633	0	on top of ridge
16:29:57	-9.52395	-13.19877	1609	345	7.0	-9.5238333	-13.19633	0	cracks running perpendicular to lava
16:30:09	-9.52395	-13.19877	1609	328	4.2	-9.5238333	-13.19633	0	HD OFF
16:30:58	-9.52392	-13.19885	1611	13	3.4	-9.5238333	-13.19633	0	more talus material
16:31:55	-9.52387	-13.19882	1610	87	4.4	-9.5238333	-13.19633	0	massive lava flow next to fracture
16:32:05	-9.52387	-13.19880	1610	86	4.4	-9.5238333	-13.19633	0	fllowing fracture, heading east
16:32:17	-9.52383	-13.19877	1609	--	--	-9.5238333	-13.19633	0	sediment at the bottom of fracture
16:33:21	-9.52377	-13.19873	1610	102	4.5	-9.5238333	-13.19633	0	still image
16:33:26	-9.52375	-13.19877	1610	94	4.8	-9.5238333	-13.19633	0	still image
16:33:42	-9.52375	-13.19873	1609	93	5.2	-9.5238333	-13.19633	0	still image of canyon
16:35:51	-9.52373	-13.19860	1613	304	7.9	-9.5238333	-13.19633	0	HD ON
16:36:08	-9.52375	-13.19862	1612	291	9.2	-9.5238333	-13.19633	0	HD pictures of canyon
16:36:32	-9.52373	-13.19862	1612	284	8.7	-9.5238333	-13.19633	0	HD OFF
16:37:09	-9.52372	-13.19863	1613	285	7.6	-9.5238333	-13.19633	0	still image
16:37:16	-9.52372	-13.19863	1612	285	9.1	-9.5238333	-13.19633	0	still image of wall
16:38:17	-9.52370	-13.19862	1615	96	4.8	-9.5238333	-13.19633	0	turning course towards East now
16:38:45	-9.52367	-13.19850	1616	90	6.8	-9.5238333	-13.19633	0	again sediment plain
16:43:56	-9.52338	-13.19770	1645	86	5.5	-9.5238333	-13.19633	0	start search pattern across the wall
16:45:53	-9.52328	-13.19732	1646	86	1.7	-9.5236673	-13.19633	0	moving east towards Eh anomaly
16:46:25	-9.52327	-13.19723	1644	85	2.7	-9.5236673	-13.19633	0	still image
16:46:33	-9.52328	-13.19723	1644	82	2.5	-9.5236673	-13.19633	0	still image of bio
16:46:57	-9.52327	-13.19718	1645	83	1.3	-9.5236673	-13.19633	0	HD ON
16:47:44	-9.52318	-13.19710	1641	80	3.9	-9.5236673	-13.19633	0	HD OFF
16:48:41	-9.52320	-13.19710	1642	80	3.5	-9.5236673	-13.19633	0	HD ON
16:49:46	-9.52315	-13.19695	1644	94	1.8	-9.5236673	-13.19633	0	HD OFF
16:51:52	-9.52288	-13.19663	1644	64	4.3	-9.5236673	-13.19633	0	sediment with ripple marks
16:51:54	-9.52288	-13.19663	1644	64	4.3	-9.5236673	-13.19633	0	
16:52:42	-9.52275	-13.19655	1640	63	5.5	-9.5236673	-13.19633	0	nice lava flow, cracked
16:53:34	-9.52268	-13.19643	1638	62	4.1	-9.5235004	-13.19633	0	lava sheet flow, lightly sedimented
16:54:06	-9.52268	-13.19647	1638	54	4.4	-9.5235004	-13.19633	0	still image
16:54:16	-9.52270	-13.19645	1638	8	4.7	-9.5235004	-13.19633	0	still image of sheet flow
16:54:39	-9.52267	-13.19652	1639	307	4.4	-9.5233326	-13.19633	0	turning vehicle to NW
16:55:39	-9.52263	-13.19667	1644	313	3.1	-9.5231667	-13.19633	0	heading 313
16:56:04	-9.52260	-13.19673	1645	313	3.1	-9.5231667	-13.19633	0	keep moving 313 over sediment
16:56:40	-9.52257	-13.19692	1647	312	2.0	-9.5229998	-13.19633	0	CTD temperature is 3.86°C
16:57:03	-9.52255	-13.19698	1648	313	1.9	-9.5229998	-13.19633	0	moved down from hill
16:59:27	-9.52243	-13.19742	1655	313	3.1	-9.5226669	-13.19633	0	differently coloured sediment
17:00:47	-9.52233	-13.19772	1651	313	3.1	-9.5223331	-13.19633	0	start moving up again, more pillows cropping out
17:02:47	-9.52218	-13.19800	1652	313	3.4	-9.5221672	-13.19633	0	1655m
17:03:57	-9.52210	-13.19812	1650	360	4.3	-9.5221672	-13.19633	0	turn to north now and proceed
17:06:12	-9.52168	-13.19818	1637	34	6.4	-9.5221672	-13.19633	0	going up a bit
17:06:32	-9.52165	-13.19813	1636	83	7.5	-9.5221672	-13.19633	0	turning on an easterly course again
17:08:17	-9.52158	-13.19772	1624	97	2.3	-9.5221672	-13.19633	0	more massive pillows and lobate flows
17:08:49	-9.52160	-13.19768	1623	90	3.9	-9.5221672	-13.19633	0	a fracture running through lava in W-E direction
17:09:57	-9.52158	-13.19747	1627	101	3.0	-9.5221672	-13.19633	0	temperature on top is 3.89°C
17:10:57	-9.52155	-13.19712	1634	90	3.0	-9.5221672	-13.19633	0	heading continuously at 92
17:11:21	-9.52150	-13.19700	1638	88	3.4	-9.5221672	-13.19633	0	reaching the edge
17:11:51	-9.52150	-13.19690	1648	89	0.9	-9.5221672	-13.19633	0	moving down into the plain
17:13:20	-9.52142	-13.19673	1651	357	9.3	-9.5221672	-13.19633	0	moving north now
17:13:35	-9.52133	-13.19677	1649	357	8.9	-9.5221672	-13.19633	0	slope with pillows and talus
17:13:53	-9.52127	-13.19680	1646	359	7.0	-9.5221672	-13.19633	0	base of talus slope at 1660m
17:14:37	-9.52120	-13.19685	1637	2	11.1	-9.5220003	-13.19633	0	pillows and obate flows on slope
17:16:53	-9.52092	-13.19692	1619	3	2.7	-9.5216665	-13.19633	0	higher up on the slope is more sediment
17:18:05	-9.52078	-13.19697	1617	3	2.6	-9.5214996	-13.19633	0	HD ON
17:18:38	-9.52075	-13.19697	1617	3	2.6	-9.5214996	-13.19633	0	HD OFF
17:19:53	-9.52067	-13.19697	1614	2	2.6	-9.5213327	-13.19633	0	lobate flows with sediment cover
17:19:55	-9.52067	-13.19697	1614	2	2.3	-9.5213327	-13.19633	0	HD ON
17:20:35	-9.52060	-13.19702	1608	5	5.3	-9.5211668	-13.19633	0	HD OFF
17:20:45	-9.52060	-13.19702	1608	21	4.9	-9.5211668	-13.19633	0	moving up a slope again
17:21:15	-9.52052	-13.19698	1607	20	4.8	-9.5211668	-13.19633	0	still image
17:21:25	-9.52052	-13.19702	1606	19	5.4	-9.5211668	-13.19633	0	crinoids and coral

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:22:16	-9.52050	-13.19700	1607	20	4.3	-9.5209999	-13.19633	0	still image
17:22:18	-9.52050	-13.19700	1606	20	4.9	-9.5209999	-13.19633	0	still image
17:23:05	-9.52045	-13.19707	1606	1	5.8	-9.520833	-13.19633	0	deep fracture, but filled with sediment
17:25:26	-9.52017	-13.19735	1615	269	1.6	-9.5205002	-13.19633	0	change to westerly course, heading 270
17:27:18	-9.52030	-13.19780	1618	277	2.2	-9.5201674	-13.19633	0	lobate flows, sediment inbetween
17:28:04	-9.52033	-13.19798	1620	341	2.3	-9.5201674	-13.19633	0	go back to course straight North
17:29:55	-9.51995	-13.19810	1621	3	3.2	-9.5200005	-13.19633	0	sediment, few pillows
17:32:31	-9.51937	-13.19830	1614	4	3.9	-9.5196667	-13.19633	0	again: sediment with few pillows
17:34:50	-9.51887	-13.19817	1607	33	6.3	-9.5193329	-13.19633	0	climbing up a more massive lava flow
17:35:32	-9.51838	-13.19827	1605	37	2.2	-9.5193329	-13.19633	0	course NE, heading 36
17:36:36	-9.51843	-13.19807	1603	41	2.6	-9.5191669	-13.19633	0	another fracture in direction NE
17:36:52	-9.51845	-13.19802	1602	42	3.1	-9.5191669	-13.19633	0	still image
17:37:01	-9.51848	-13.19802	1602	40	3.6	-9.5191669	-13.19633	0	still image
17:37:08	-9.51848	-13.19802	1601	39	4.1	-9.5191669	-13.19633	0	still image of fracture
17:38:00	-9.51835	-13.19803	1601	8	3.1	-9.5190001	-13.19633	0	however, fracture is filled with sediment
17:39:11	-9.51805	-13.19812	1599	36	4.0	-9.5188332	-13.19633	0	change course again to 30°
17:39:27	-9.51800	-13.19807	1600	92	5.2	-9.5188332	-13.19633	0	turn to 90° heading
17:39:48	-9.51798	-13.19793	1605	94	2.4	-9.5186672	-13.19633	0	slope going done, more sediment coming in
17:40:27	-9.51800	-13.19788	1611	94	1.7	-9.5186672	-13.19633	0	moving east across edge
17:43:04	-9.51785	-13.19728	1619	90	2.2	-9.5185003	-13.19633	0	continue east, more pillows and lobate flows, less sediment
17:43:44	-9.51780	-13.19715	1622	91	1.1	-9.5185003	-13.19633	0	over the edge
17:43:59	-9.51780	-13.19710	1625	88	0.9	-9.5185003	-13.19633	0	and down theslope
17:46:05	-9.51778	-13.19687	1653	324	3.5	-9.5185003	-13.19633	0	1655m base of edge
17:46:15	-9.51773	-13.19687	1652	323	3.5	-9.5185003	-13.19633	0	HD ON
17:47:16	-9.51768	-13.19683	1647	88	9.4	-9.5185003	-13.19633	0	looking around: talus
17:47:49	-9.51772	-13.19685	1645	183	12.9	-9.5185003	-13.19633	0	temperature changed from 3.88 to 3.87°C
17:48:08	-9.51778	-13.19682	1644	179	13.5	-9.5185003	-13.19633	0	finish search pattern at the steep wall
17:48:27	-9.51780	-13.19683	1644	178	13.9	-9.5185003	-13.19633	0	now move to large "volcano" that showed the Eh anomaly
17:49:18	-9.51792	-13.19673	1645	177	15.5	-9.5185003	-13.19633	0	change course to 165 and proceed
17:49:30	-9.51798	-13.19672	1647	172	15.0	-9.5185003	-13.19633	0	900m to go
17:50:43	-9.51825	-13.19662	1662	173	4.5	-9.5185003	-13.19633	0	lava
17:51:06	-9.51822	-13.19660	1658	171	7.6	-9.5185003	-13.19633	0	lava blocks
17:52:49	-9.51862	-13.19650	1669	162	4.7	-9.5186672	-13.19617	0	sediment with ripple marks
17:54:07	-9.51888	-13.19648	1671	174	2.9	-9.5186672	-13.19617	0	going down slope
17:54:21	-9.51893	-13.19642	1670	174	3.9	-9.5188332	-13.19617	0	pillows with sediment inbetween
17:58:24	-9.51948	-13.19632	1663	181	2.2	-9.5193329	-13.19600	0	continue south
17:58:26	-9.51948	-13.19632	1662	181	2.4	-9.5193329	-13.19600	0	still image
17:58:40	-9.51948	-13.19632	1661	180	3.6	-9.5194998	-13.19600	0	still image of bio on pillow
17:58:56	-9.51953	-13.19632	1661	181	3.1	-9.5194998	-13.19600	0	sediment with ripple marks
17:59:38	-9.51967	-13.19630	1658	174	6.6	-9.5196667	-13.19600	0	sediment ends, now talus
18:00:35	-9.51985	-13.19608	1654	168	8.5	-9.5196667	-13.19600	0	moving up across large talus fan
18:10:29	-9.52025	-13.19590	1654	93	6.5	-9.5211668	-13.19567	0	move towards east, heading 95, to centre of redox anomaly
18:11:03	-9.52022	-13.19587	1657	91	4.9	-9.5211668	-13.19567	0	250m to east
18:14:07	-9.52007	-13.19535	1669	109	3.1	-9.5211668	-13.19550	0	pilows with sediment inbetween
18:17:43	-9.52020	-13.19493	1674	120	2.0	-9.5211668	-13.19500	0	still image
18:17:47	-9.52020	-13.19493	1674	119	2.1	-9.5211668	-13.19483	0	sponge
18:18:26	-9.52018	-13.19492	1674	120	2.1	-9.5211668	-13.19483	0	HD ON
18:18:45	-9.52018	-13.19490	1674	119	2.1	-9.5211668	-13.19483	0	still image
18:19:27	-9.52020	-13.19492	1674	119	2.1	-9.5211668	-13.19467	0	still image
18:19:32	-9.52020	-13.19492	1674	119	2.1	-9.5211668	-13.19467	0	HD OFF
18:23:54	-9.52037	-13.19440	1667	114	3.4	-9.5211668	-13.19433	0	more sediment now
18:25:16	-9.52038	-13.19425	1669	122	2.4	-9.5211668	-13.19417	0	at the base of a small hill, pilows and lobate flows with sediment inbetween
18:30:11	-9.52048	-13.19358	1655	95	2.6	-9.5211668	-13.19350	0	nothing special in centre of anomaly
18:35:32	-9.52048	-13.19300	1656	139	3.0	-9.5211668	-13.19333	0	we fllowed anomaly to east towards the end
18:35:41	-9.52052	-13.19297	1656	151	3.2	-9.5211668	-13.19333	0	now turning south and proceed for 30m
18:36:06	-9.52055	-13.19302	1654	191	3.6	-9.5211668	-13.19333	0	still image
18:36:23	-9.52048	-13.19297	1655	188	3.4	-9.5211668	-13.19333	0	large pillows and lobate flow with sediment inbetween
18:39:33	-9.52055	-13.19303	1654	182	3.5	-9.5211668	-13.19333	0	flying south
18:43:46	-9.52077	-13.19323	1652	270	1.7	-9.5211668	-13.19333	0	Seeigel
18:44:12	-9.52078	-13.19323	1652	257	1.7	-9.5211668	-13.19333	0	sedimented plain
18:45:38	-9.52080	-13.19333	1651	273	1.9	-9.5211668	-13.19333	0	pillow lava, > 50% sediment
18:47:09	-9.52082	-13.19347	1650	273	1.7	-9.5211668	-13.19333	0	pillow lava, > 50% sediment
18:51:07	-9.52088	-13.19422	1660	273	1.8	-9.5211668	-13.19333	0	still heading to West; going slightly down; lots of sediments and blocks of pillows
18:52:22	-9.52092	-13.19438	1659	273	3.2	-9.5211668	-13.19333	0	blocks of sheet flow, showing parallel structures
18:53:47	-9.52092	-13.19442	1659	273	3.0	-9.5211668	-13.19333	0	probably finegrained talus of pillow bas, sedimented in the pool
18:54:15	-9.52093	-13.19445	1659	273	3.0	-9.5211668	-13.19333	0	lobate flow, < 50 % sediment
18:56:55	-9.52092	-13.19447	1659	273	3.1	-9.5211668	-13.19333	0	moving up the hill to the west (last time)
18:59:21	-9.52095	-13.19478	1659	273	3.5	-9.5211668	-13.19333	0	a deep filled with sediments before us
19:01:20	-9.52102	-13.19485	1661	180	2.7	-9.5211668	-13.19333	0	nice sedimentary structures: arrangement of white and black sediments
19:01:32	-9.52100	-13.19485	1661	180	2.7	-9.5211668	-13.19333	0	turning the ROV to South
19:03:20	-9.52113	-13.19480	1658	180	2.7	-9.5211668	-13.19333	0	lobate flow, > 50 % sediment
19:04:32	-9.52130	-13.19473	1652	180	2.9	-9.5211668	-13.19333	0	lobate flow, > 50 % sediment
19:04:56	-9.52133	-13.19472	1651	180	3.0	-9.5213327	-13.19333	0	HD ON
19:05:28	-9.52133	-13.19473	1650	191	3.9	-9.5213327	-13.19333	0	HD OFF
19:05:49	-9.52135	-13.19477	1650	191	3.9	-9.5213327	-13.19333	0	block with nice coral assemvlage
19:05:55	-9.52133	-13.19477	1650	191	4.0	-9.5213327	-13.19333	0	still image
19:07:36	-9.52137	-13.19472	1648	195	4.2	-9.5214996	-13.19333	0	sediment with ripple marks
19:12:19	-9.52220	-13.19472	1635	184	2.4	-9.5220003	-13.19350	0	sediments with blocks of pillows bas
19:13:18	-9.52240	-13.19467	1634	185	1.9	-9.5221672	-13.19350	0	sediment
19:15:46	-9.52265	-13.19457	1634	190	0.9	-9.5225	-13.19367	0	looking for the white spots in the sediments

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
19:17:17	-9.52263	-13.19462	1634	191	0.9	-9.5228329	-13.19367	0	white spots are small pit of sediments
19:17:56	-9.52263	-13.19460	1634	200	0.9	-9.5228329	-13.19367	0	HD ON
19:17:57	-9.52263	-13.19460	1634	200	0.9	-9.5228329	-13.19367	0	HD OFF
19:19:05	-9.52263	-13.19460	1634	177	0.9	-9.5229998	-13.19367	0	probably sorted sediments; black iso-grained pillow basalt talus and white sedeiment
19:20:30	-9.52278	-13.19458	1633	178	1.3	-9.5233326	-13.19383	0	still heading to south; sediments with some blocks of lava
19:22:13	-9.52302	-13.19450	1632	177	1.4	-9.5235004	-13.19383	0	Seeigel
19:22:46	-9.52305	-13.19452	1633	178	1.3	-9.5235004	-13.19383	0	still image
19:24:29	-9.52330	-13.19447	1632	177	1.3	-9.5236673	-13.19383	0	recrangular fault system
19:25:13	-9.52342	-13.19445	1634	177	2.2	-9.5238333	-13.19383	1627	small step down to another sediment plain
19:26:28	-9.52360	-13.19442	1632	178	2.2	-9.5240002	-13.19383	1625	"wall" of pillow blocks
19:27:35	-9.52375	-13.19437	1629	182	2.2	-9.5240002	-13.19383	1621	more rocks
19:28:26	-9.52390	-13.19437	1626	190	2.6	-9.5241671	-13.19383	1623	lobate flow, > 50 % sediment
19:30:54	-9.52422	-13.19447	1621	165	3.0	-9.5244999	-13.19400	1624	start of rupture running NS
19:31:31	-9.52418	-13.19448	1620	183	4.6	-9.5244999	-13.19400	1613	pillow lava, < 50% sediment
19:32:54	-9.52447	-13.19448	1617	190	3.1	-9.5246668	-13.19400	1616	looks like a wall running N-S
19:36:50	-9.52485	-13.19455	1611	184	3.1	-9.5246668	-13.19400	1618	We are now in the center of the ABYSS map
19:37:47	-9.52497	-13.19457	1613	184	2.9	-9.5246668	-13.19400	1621	lobate flow, > 50 % sediment
19:40:19	-9.52507	-13.19460	1612	290	3.0	-9.5246668	-13.19400	1611	lobate flow, > 50 % sediment
19:42:14	-9.52508	-13.19488	1613	291	2.8	-9.5246668	-13.19400	1617	sediment with ripple marks
19:42:25	-9.52505	-13.19495	1613	291	3.0	-9.5246668	-13.19400	1613	fish
19:43:00	-9.52682	-13.19835	1613	291	3.1	-9.5246668	-13.19400	1612	lobate flow, > 50 % sediment
19:43:56	-9.52500	-13.19533	1620	285	2.9	-9.5246668	-13.19417	1618	heading to 300 since a while
19:46:53	-9.52482	-13.19592	1631	298	2.2	-9.5244999	-13.19467	1611	sediments with some blocks of pillow basalt
19:50:29	-9.52457	-13.19650	1634	--	--	-9.524333	-13.19533	1622	still sedimented plateau with some pillow blocks
19:51:13	-9.52448	-13.19665	1635	315	3.2	-9.524333	-13.19550	1625	heading 200, to a weight point called "anomaly"
19:52:40	-9.52432	-13.19682	1636	332	3.1	-9.524333	-13.19567	1631	problems with flickering in the HD image
19:53:05	-9.52427	-13.19687	1636	337	3.2	-9.524333	-13.19583	1633	fish
19:54:24	-9.52413	-13.19697	1638	343	3.1	-9.5241671	-13.19600	1632	weight point reached; still sediments with blocks of pillows
19:59:51	-9.52415	-13.19702	1640	51	3.1	-9.5240002	-13.19667	1635	checking the direction of the current: to West
20:00:36	-9.52408	-13.19695	1641	55	3.1	-9.5240002	-13.19667	1637	heading to NE into a region which was probably investigated some hours ago
20:01:49	-9.52390	-13.19683	1640	54	3.0	-9.5240002	-13.19667	1634	flying against the current to NE
20:02:46	-9.52372	-13.19672	1641	54	3.0	-9.5240002	-13.19667	1634	pillow lava, > 50% sediment
20:18:26	-9.52263	-13.19578	1635	131	3.0	-9.5229998	-13.19483	1630	after long discussion based on the new ABYSS map heading to SE
20:19:54	-9.52278	-13.19553	1634	125	3.0	-9.5229998	-13.19483	1629	sediment
20:21:52	-9.52298	-13.19513	1631	120	3.0	-9.5229998	-13.19467	1629	still sediments with some blocks of jumbled lava
20:23:49	-9.52317	-13.19493	1633	153	3.1	-9.5231667	-13.19467	1629	sediments with wall of rocks, like a dam
20:24:03	-9.52325	-13.19492	1633	152	3.4	-9.5231667	-13.19450	1629	sheet flow, > 50 % sediment
20:25:17	-9.52338	-13.19482	1633	153	3.3	-9.5233326	-13.19450	1629	sediment with ripple marks
20:26:40	-9.52355	-13.19473	1633	150	3.1	-9.5233326	-13.19450	1635	another wall crossing (representing top of a sheet flow?)
20:27:08	-9.52352	-13.19473	1633	150	3.1	-9.5233326	-13.19433	1629	still image
20:27:14	-9.52352	-13.19473	1633	150	3.3	-9.5233326	-13.19433	1629	still image
20:27:17	-9.52352	-13.19473	1633	151	3.2	-9.5233326	-13.19433	1626	still image
20:28:03	-9.52358	-13.19468	1631	145	3.2	-9.5233326	-13.19433	1633	HD ON
20:28:41	-9.52357	-13.19467	1631	145	3.2	-9.5233326	-13.19433	1633	small clams
20:28:48	-9.52355	-13.19465	1631	145	3.4	-9.5233326	-13.19433	1631	small clams
20:29:02	-9.52355	-13.19467	1631	145	2.9	-9.5233326	-13.19433	1630	HD OFF
20:30:22	-9.52358	-13.19465	1632	146	2.2	-9.5235004	-13.19433	1630	HD OFF
20:30:24	-9.52358	-13.19467	1632	145	2.2	-9.5235004	-13.19433	1630	still image
20:30:25	-9.52358	-13.19467	1632	145	2.2	-9.5235004	-13.19433	1629	still image
20:30:34	-9.52358	-13.19467	1632	145	2.2	-9.5235004	-13.19433	1629	still image
20:30:51	-9.52357	-13.19468	1632	145	1.9	-9.5235004	-13.19433	1630	sheet flow, > 50 % sediment
20:31:16	-9.52358	-13.19462	1633	145	0.4	-9.5235004	-13.19433	1624	HD ON
20:32:04	-9.52358	-13.19462	1632	147	0.6	-9.5235004	-13.19433	1628	HD OFF
20:32:25	-9.52360	-13.19460	1632	187	1.3	-9.5235004	-13.19433	1628	sediment
20:34:00	-9.52357	-13.19445	1631	142	1.7	-9.5235004	-13.19417	1626	heading 120
20:34:27	-9.52365	-13.19432	1630	141	2.3	-9.5236673	-13.19417	1628	sheet flow, > 50 % sediment
20:34:44	-9.52363	-13.19430	1628	141	2.5	-9.5236673	-13.19400	1625	sheet folws with jumbled surface
20:37:41	-9.52395	-13.19393	1629	184	3.9	-9.5240002	-13.19367	1626	still plain with sediments; some blocks of basalt
20:39:25	-9.52397	-13.19382	1628	160	4.3	-9.5241671	-13.19350	1626	Rov is drifted to the North; thus current from the South
20:40:28	-9.52407	-13.19375	1627	159	4.1	-9.5241671	-13.19333	1627	jumbled lava
20:40:53	-9.52408	-13.19370	1627	157	4.0	-9.524333	-13.19333	1626	sheet flow, > 50 % sediment
20:41:20	-9.52410	-13.19363	1627	159	4.1	-9.524333	-13.19317	1626	still image
20:41:40	-9.52408	-13.19363	1627	159	4.5	-9.524333	-13.19317	1626	still image
20:42:28	-9.52413	-13.19357	1627	161	4.8	-9.5244999	-13.19300	1627	peak of sand before us
20:43:46	-9.52415	-13.19333	1627	150	4.8	-9.5246668	-13.19283	1625	sediment plain with basalt boulders
20:45:21	-9.52437	-13.19322	1626	168	5.0	-9.5246668	-13.19267	1625	sediment
20:46:21	-9.52447	-13.19308	1626	166	4.8	-9.5248327	-13.19267	1626	fish
20:48:19	-9.52472	-13.19290	1625	173	4.6	-9.5248327	-13.19267	1625	slight increase in ctd temperature
20:49:32	-9.52495	-13.19292	1626	187	4.5	-9.5248327	-13.19267	1627	sheet flow, > 50 % sediment
20:51:07	-9.52538	-13.19310	1627	188	4.9	-9.5248327	-13.19267	1627	still sediments with basalt blocks
20:52:31	-9.52567	-13.19315	1627	166	4.6	-9.5249996	-13.19250	1628	same as before
20:55:32	-9.52610	-13.19302	1628	174	4.6	-9.5253334	-13.19267	1629	sediments with dunes; black and white sutff is separated
20:57:13	-9.52617	-13.19292	1632	179	1.0	-9.5256672	-13.19267	1628	HD ON
20:57:30	-9.52620	-13.19295	1632	179	1.7	-9.5256672	-13.19267	1627	lift off
20:57:58	-9.52620	-13.19288	1624	179	8.8	-9.5258331	-13.19267	1627	HD OFF
20:58:16	-9.52625	-13.19288	1621	179	11.6	-9.5258331	-13.19267	1627	OFF THE BOTTOM
22:09:45	-9.52507	-13.19468	18	--	--	-9.5258331	-13.19183	1639	ON DECK

Cruise: MAR SOUTH V
Date: 02.05.2009
Station: M78-2_335ROV
Targets: Lilliput

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
11:44:26	0.00000	0.00000	0	--	--	-9.5471668	-13.20950	0	IN THE WATER
12:27:15	-9.54733	-13.20913	1261	311	0.0	-9.5473328	-13.20867	1494	1250 m ROV descending ok
12:28:48	-9.54733	-13.20915	1322	311	0.0	-9.5473328	-13.20850	1493	OBJECTIVE: Re-sample Liliput Main diffuse fluid (tidal experiment sampling #4), sample mussels, explore area southwards Roman City into unknown areas
12:33:51	-9.54747	-13.20930	1474	27	18.3	-9.5473328	-13.20850	1492	AT THE BOTTOM
12:34:23	-9.54750	-13.20933	1476	27	16.7	-9.5473328	-13.20850	1495	Bottom sight
12:34:32	-9.54750	-13.20933	1478	27	15.1	-9.5473328	-13.20850	1492	
12:35:17	-9.54748	-13.20937	1480	28	12.8	-9.5473328	-13.20850	1491	going to SMoni reference site
12:39:20	-9.54743	-13.20925	1492	98	2.2	-9.5473328	-13.20850	1492	marker ar sampling site in view number 46
12:42:17	-9.54745	-13.20917	1493	295	1.3	-9.5473328	-13.20850	1493	positioning ourselves
12:44:18	-9.54745	-13.20918	1494	277	0.4	-9.5473328	-13.20850	1492	marker number 42 not 46
12:53:33	-9.54745	-13.20920	1494	276	0.5	-9.5473328	-13.20850	1492	KIPS ON
12:53:34	-9.54733	-13.20915	1494	276	0.5	-9.5473328	-13.20850	1493	**335 ROV 1 (KIPS A2)**
12:57:39	-9.54745	-13.20920	1494	276	0.5	-9.5473328	-13.20850	1494	KIPS OFF
12:57:59	-9.54743	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1497	KIPS ON
12:58:00	-9.54743	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1497	sample
12:58:29	-9.54743	-13.20920	1494	276	0.5	-9.5473328	-13.20850	1492	**335 ROV 2 (KIPS A3) temperatute constant at 9°C**
13:03:08	-9.54747	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1494	KIPS OFF
13:03:25	-9.54745	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1492	KIPS ON
13:03:26	-9.54745	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1492	**335 ROV 3 (KIPS B4)**
13:08:38	-9.54743	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1494	KIPS OFF
13:09:09	-9.54745	-13.20922	1494	276	0.5	-9.5474997	-13.20850	1503	KIPS ON
13:09:16	-9.54747	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1503	**335 ROV 4 (KIPS A1) in situ**
13:10:47	-9.54742	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1492	still image
13:10:47	-9.54742	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1492	still image
13:14:22	-9.54747	-13.20918	1494	276	0.5	-9.5473328	-13.20850	1501	KIPS OFF
13:14:41	-9.54747	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1502	dosierpum on
13:16:12	-9.54745	-13.20922	1494	276	0.5	-9.5473328	-13.20850	1491	dosierpump off
13:19:15	-9.54747	-13.20920	1494	275	0.4	-9.5473328	-13.20850	1492	3-D imaging
13:26:09	-9.54742	-13.20925	1494	264	0.2	-9.5473328	-13.20850	1493	HD on for 3d imaging
13:32:49	-9.54745	-13.20925	1493	322	1.5	-9.5473328	-13.20850	1497	3d imaging finished
13:36:02	-9.54747	-13.20930	1493	322	1.5	-9.5473328	-13.20850	1493	grabbing the net
13:41:29	-9.54752	-13.20930	1492	322	1.6	-9.5473328	-13.20850	1491	open grey box, gran net
13:45:16	-9.54737	-13.20928	1494	50	0.2	-9.5473328	-13.20850	1494	spotted some "large" mussels
13:47:29	-9.54747	-13.20925	1494	50	0.2	-9.5473328	-13.20850	1495	**335 ROV 5 mussel net**
13:49:03	-9.54747	-13.20928	1494	51	0.2	-9.5473328	-13.20850	1492	got two grabs including some "large" specimens
13:49:13	-9.54748	-13.20927	1494	51	0.2	-9.5473328	-13.20850	1491	look for another spot
13:55:05	-9.54700	-13.20773	1494	55	0.2	-9.5473328	-13.20850	1501	scratching mussels from pillow lava crack
13:57:24	-9.54752	-13.20927	1493	71	1.3	-9.5473328	-13.20850	1492	lift off to look for more bigger mussels
14:02:08	-9.54743	-13.20915	1494	23	0.3	-9.5473328	-13.20850	1494	taking mussels
14:02:19	-9.54743	-13.20915	1494	24	0.3	-9.5473328	-13.20850	1490	shrimp, scattered
14:07:20	-9.54742	-13.20917	1494	24	0.4	-9.5473328	-13.20850	1491	scratching off mussels with net produced dirt cloud
14:10:13	-9.54743	-13.20917	1494	23	0.2	-9.5473328	-13.20850	1493	transfering net into grey box
14:18:22	-9.54747	-13.20918	1494	24	0.2	-9.5473328	-13.20850	1493	picking up slurp gun
14:19:53	-9.54743	-13.20920	1494	24	0.3	-9.5473328	-13.20850	1491	HD ON
14:20:43	-9.54802	-13.20938	1494	24	0.3	-9.5473328	-13.20850	1492	**335 ROV 6 slurp gun**
14:20:55	-9.54743	-13.20918	1494	23	0.4	-9.5473328	-13.20850	1492	slurping shrimps
14:25:13	-9.54743	-13.20917	1494	63	0.4	-9.5473328	-13.20850	1503	HD OFF
14:28:06	-9.54743	-13.20920	1493	65	0.6	-9.5473328	-13.20850	1492	slurp gun not strong enough to slurp shrimps
14:31:47	-9.54743	-13.20920	1494	64	0.3	-9.5473328	-13.20850	1492	sample STOP
14:33:42	-9.54745	-13.20918	1492	136	1.4	-9.5473328	-13.20850	1493	change topic.....heading to Roman City
14:34:57	-9.54757	-13.20917	1490	171	3.4	-9.5474997	-13.20850	1491	first: heading to Limtoc
14:35:48	-9.54772	-13.20913	1490	171	3.6	-9.5474997	-13.20850	1492	Fe oxides crusts
14:37:35	-9.54812	-13.20907	1492	171	3.0	-9.5476665	-13.20850	1491	pillow lava, < 50% sediment
14:38:17	-9.54823	-13.20903	1492	165	1.3	-9.5478334	-13.20850	1492	flying over a small pillow hill
14:38:34	-9.54825	-13.20905	1492	159	1.6	-9.5478334	-13.20850	1492	still lots of Fe-crust#
14:40:28	-9.54847	-13.20893	1493	160	1.9	-9.5481672	-13.20850	1494	lobate flow, < 50 % sediment
14:42:52	-9.54867	-13.20880	1494	167	0.5	-9.5485001	-13.20833	1490	mussel patch
14:43:32	-9.54872	-13.20878	1493	168	1.5	-9.548667	-13.20833	1488	coral
14:43:52	-9.54872	-13.20880	1492	164	2.8	-9.548667	-13.20833	1491	still image
14:45:18	-9.54887	-13.20868	1492	164	1.8	-9.5488329	-13.20833	1492	lobate flow, unsedimented
14:45:50	-9.54893	-13.20867	1493	159	1.8	-9.5489998	-13.20833	1489	iron oxide crust
14:50:07	-9.54938	-13.20842	1491	161	1.7	-9.5496674	-13.20817	1488	lots of iron oxid crust
14:50:36	-9.54938	-13.20838	1491	195	1.6	-9.5496674	-13.20817	1489	looking around at this place
14:51:00	-9.54937	-13.20843	1491	216	1.6	-9.5498333	-13.20817	1490	HD ON
14:51:56	-9.54937	-13.20843	1491	122	1.9	-9.5500002	-13.20817	1488	HD OFF
14:52:52	-9.54948	-13.20835	1490	167	1.6	-9.5500002	-13.20817	1489	heading on to South
14:53:06	-9.54952	-13.20835	1489	167	1.9	-9.5500002	-13.20817	1490	lobate flow, unsedimented
14:54:22	-9.54980	-13.20828	1491	172	0.8	-9.5500002	-13.20800	1489	just passed a small hill
14:54:30	-9.54983	-13.20825	1491	172	1.8	-9.5500002	-13.20800	1489	lobate flow, slightly sedimented
14:56:00	-9.55003	-13.20820	1492	179	0.4	-9.5500002	-13.20800	1489	lobate flow, unsedimented
14:56:30	-9.55007	-13.20817	1492	168	0.5	-9.5500002	-13.20800	1489	still image
14:58:42	-9.55035	-13.20813	1493	181	0.5	-9.5500002	-13.20800	1488	drained lobe, small garage
15:00:12	-9.55047	-13.20812	1491	186	1.7	-9.5500002	-13.20800	1490	ruin features; pillars and a roof
15:00:38	-9.55045	-13.20810	1492	190	1.1	-9.5500002	-13.20800	1488	HD ON
15:01:15	-9.55048	-13.20812	1492	198	1.0	-9.5500002	-13.20800	1489	HD OFF
15:04:05	-9.55047	-13.20815	1490	197	2.8	-9.5500002	-13.20800	1489	we are now in Limtoc

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
15:07:34	-9.55082	-13.20815	1492	178	3.0	-9.5500002	-13.20800	1490	drainage structures
15:08:14	-9.55090	-13.20810	1491	170	3.9	-9.5500002	-13.20800	1488	heading to the hill 1470 North of Roman City
15:11:25	-9.55113	-13.20792	1489	154	3.8	-9.5500002	-13.20800	1489	still image
15:11:53	-9.55110	-13.20790	1490	157	3.4	-9.5500002	-13.20800	1486	flying along a small graben right, pillars left
15:13:18	-9.55122	-13.20780	1490	156	4.4	-9.5501671	-13.20800	1489	nice little rooms
15:13:33	-9.55122	-13.20780	1491	145	3.8	-9.5501671	-13.20800	1490	HD ON
15:14:47	-9.55127	-13.20780	1491	129	4.5	-9.550333	-13.20783	1489	HD ON
15:15:36	-9.55132	-13.20772	1489	176	4.9	-9.550333	-13.20783	1488	very nice HD seqence landing in a place before ruins with lots of draining structures, pillars
15:16:05	-9.55137	-13.20768	1489	155	4.8	-9.5504999	-13.20783	1488	going on to head to the hill
15:21:06	-9.55172	-13.20740	1492	167	2.2	-9.5511665	-13.20733	1491	lobate flow, some lobes are hollow and broken
15:23:22	-9.55185	-13.20737	1493	160	1.4	-9.5515003	-13.20717	1490	collapsed hollow lobe
15:26:26	-9.55197	-13.20733	1492	179	1.6	-9.5516672	-13.20717	1489	many collapsed structures
15:28:10	-9.55213	-13.20732	1492	180	1.6	-9.5516672	-13.20717	1490	HD ON
15:28:25	-9.55212	-13.20737	1492	179	1.4	-9.5516672	-13.20717	1489	iron oxide coated collapse structues
15:29:08	-9.55215	-13.20738	1492	180	1.6	-9.5516672	-13.20717	1491	deep hole below us
15:29:59	-9.55222	-13.20733	1492	--	--	-9.5516672	-13.20700	1490	bizarr
15:30:02	-9.55222	-13.20733	1492	169	2.2	-9.5516672	-13.20700	1490	still image
15:30:38	-9.55222	-13.20732	1491	193	2.6	-9.5518332	-13.20700	1490	HD OFF
15:38:55	-9.54878	-13.20798	1491	182	2.6	-9.5530005	-13.20667	0	attempt to take a sample with a net
15:41:58	-9.55220	-13.20723	1492	205	1.5	-9.5535002	-13.20650	0	HD ON
15:43:10	-9.55220	-13.20722	1493	206	0.2	-9.5536671	-13.20650	0	HD OFF
15:49:37	-9.55217	-13.20725	1493	207	0.2	-9.5536671	-13.20633	0	successfully sampled
15:49:40	-9.55217	-13.20725	1493	207	0.2	-9.5536671	-13.20633	0	**335 ROV 7 net**
15:50:33	-9.55222	-13.20720	1493	207	0.2	-9.5536671	-13.20633	0	placing the net into the back of the drawer
15:51:00	-9.55220	-13.20720	1493	207	0.2	-9.5536671	-13.20633	0	sampled material behaves like mud, dust
15:54:21	-9.55215	-13.20718	1493	207	0.3	-9.5536671	-13.20633	0	HD ON
15:54:29	-9.55218	-13.20717	1493	207	0.3	-9.5536671	-13.20633	0	take off
15:55:24	-9.55223	-13.20720	1491	207	1.5	-9.5536671	-13.20633	0	HD OFF
15:55:52	-9.55227	-13.20727	1491	181	2.4	-9.5536671	-13.20633	0	Fe oxide trees rooting at the bottom of ruins
15:57:13	-9.55232	-13.20707	1491	205	4.0	-9.553833	-13.20633	0	still ruins
15:57:39	-9.55248	-13.20725	1492	208	1.1	-9.553833	-13.20633	0	HD ON
15:57:58	-9.55255	-13.20723	1491	208	2.2	-9.553833	-13.20633	0	needles of what?
15:58:01	-9.55255	-13.20723	1491	208	2.4	-9.553833	-13.20633	0	shimmering water
15:59:24	-9.55257	-13.20727	1491	196	2.1	-9.553833	-13.20633	0	HD OFF
15:59:26	-9.55257	-13.20727	1491	196	2.2	-9.553833	-13.20633	0	HD ON
15:59:32	-9.55260	-13.20725	1491	196	1.9	-9.553833	-13.20633	0	HD OFF
15:59:57	-9.55258	-13.20725	1491	188	2.3	-9.553833	-13.20633	0	still image
16:00:24	-9.55257	-13.20727	1491	169	2.1	-9.553833	-13.20633	0	attempt to take a sample
16:00:53	-9.55260	-13.20725	1491	169	2.2	-9.553833	-13.20633	0	still image
16:01:16	-9.55258	-13.20725	1491	169	2.0	-9.553833	-13.20633	0	no sample
16:04:42	-9.55282	-13.20740	1483	--	--	-9.553833	-13.20633	0	climbing the hill South of Roman City
16:05:06	-9.55285	-13.20742	1481	240	3.0	-9.553833	-13.20633	0	pillow lava, unsedimented
16:05:33	-9.55287	-13.20745	1480	240	2.6	-9.553833	-13.20633	0	lobate flow, unsedimented
16:06:45	-9.55290	-13.20743	1475	240	4.3	-9.553833	-13.20633	0	HD ON
16:08:44	-9.55292	-13.20747	1475	277	2.4	-9.553833	-13.20633	0	HD OFF
16:09:00	-9.55293	-13.20747	1475	277	2.5	-9.553833	-13.20633	0	still image off pink coral
16:10:20	-9.55295	-13.20750	1475	278	1.4	-9.553833	-13.20633	0	still image
16:11:07	-9.55293	-13.20747	1474	264	3.1	-9.553833	-13.20633	0	beautiful pillows with corals
16:12:33	-9.55307	-13.20752	1471	251	1.8	-9.553833	-13.20633	0	HD ON
16:13:33	-9.55312	-13.20753	1471	314	1.4	-9.553833	-13.20633	0	HD OFF
16:13:54	-9.55310	-13.20755	1470	275	1.8	-9.553833	-13.20633	0	very beautiluf HD footage of fauna on pillows !!
16:14:46	-9.55320	-13.20750	1467	186	3.1	-9.553833	-13.20633	0	Fe-oxide staing between pillows
16:17:24	-9.55363	-13.20740	1463	244	0.8	-9.553833	-13.20633	0	Fe-oxide chimneys near the top (plus 1 coral)
16:17:27	-9.55363	-13.20740	1463	244	0.8	-9.553833	-13.20633	0	HD ON
16:18:07	-9.55367	-13.20737	1462	236	1.7	-9.553833	-13.20633	0	HD OFF
16:20:11	-9.55377	-13.20743	1465	322	2.8	-9.553833	-13.20633	0	still image
16:22:31	-9.55367	-13.20760	1464	356	1.2	-9.553833	-13.20633	0	extensive Fe-oxide cover on the top; but seems cold (cooling of the pillow itself (?) rather than deep reaching hydrothermal system?
16:22:47	-9.55362	-13.20762	1464	357	1.5	-9.553833	-13.20633	0	pillows with some Fe-oxides
16:23:44	-9.55355	-13.20765	1467	0	0.7	-9.553833	-13.20633	0	pillows cut by small fissure (visible on ABE bathymetry)
16:25:47	-9.55347	-13.20772	1469	7	3.7	-9.553833	-13.20633	0	still image
16:26:02	-9.55345	-13.20770	1469	7	4.5	-9.553833	-13.20633	0	still image of Fe-oxide coated pilows cut by fracture
16:29:39	-9.55333	-13.20772	1465	182	3.6	-9.553833	-13.20633	0	fault trends NS
16:30:02	-9.55338	-13.20762	1465	139	2.9	-9.553833	-13.20633	0	again abundant Fe-oxides covering the pillows (up to 1 m thick?)
16:30:26	-9.55338	-13.20758	1464	135	2.6	-9.553833	-13.20633	0	turning SE to fly to elongated ridge south of this mound
16:30:35	-9.55338	-13.20755	1464	135	2.7	-9.553833	-13.20633	0	pillow lava, unsedimented
16:31:58	-9.55343	-13.20745	1463	135	1.9	-9.553833	-13.20633	0	HD ON
16:32:26	-9.55342	-13.20747	1463	136	1.9	-9.553833	-13.20633	0	HD OFF
16:32:51	-9.55345	-13.20742	1463	135	2.0	-9.553833	-13.20633	0	few corals and crinoids on unsedimented pillows
16:33:51	-9.55347	-13.20732	1465	136	2.3	-9.553833	-13.20633	0	at mound rim, flying downhill (steep slope)
16:36:15	-9.55360	-13.20713	1477	213	4.4	-9.553833	-13.20633	0	HD ON
16:37:20	-9.55370	-13.20710	1475	291	8.5	-9.553833	-13.20633	0	Fe-oxide chimneys
16:37:38	-9.55375	-13.20715	1475	324	9.2	-9.553833	-13.20633	0	HD OFF
16:37:52	-9.55377	-13.20715	1475	353	9.0	-9.553833	-13.20633	0	tree-like Fe-oxide chimneys
16:39:51	-9.55368	-13.20705	1474	127	9.3	-9.553833	-13.20633	0	going back to SE; we are almost at the base of the mound
16:40:47	-9.55360	-13.20698	1485	116	2.3	-9.553833	-13.20633	0	jumbled sheet flows (thats new)
16:41:32	-9.55363	-13.20690	1485	121	2.2	-9.553833	-13.20633	0	approaching area with lava drainage (pancakes, skylights everywhere)
16:41:52	-9.55363	-13.20687	1485	121	2.2	-9.553833	-13.20633	0	still image

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
16:42:47	-9.55363	-13.20682	1484	121	1.6	-9.553833	-13.20633	0	still image
16:42:50	-9.55363	-13.20677	1484	121	1.7	-9.553833	-13.20633	0	lobate flows; empty underneath
16:43:32	-9.55365	-13.20667	1485	118	1.3	-9.553833	-13.20633	0	lobate flow, unsedimented
16:44:39	-9.55372	-13.20652	1484	154	1.8	-9.553833	-13.20617	0	lobate flow, unsedimented
16:45:07	-9.55377	-13.20650	1484	155	1.3	-9.553833	-13.20617	0	more broken sheets
16:45:49	-9.55387	-13.20643	1483	155	1.6	-9.553833	-13.20617	0	jumbled lava
16:47:17	-9.55402	-13.20638	1482	175	1.8	-9.5539999	-13.20600	0	climbing up a ridge of jumbled lava (pressure ridge?)
16:47:51	-9.55412	-13.20635	1483	174	1.2	-9.5539999	-13.20600	0	contact of jumbled lava and sheet flow
16:48:21	-9.55413	-13.20635	1484	174	1.1	-9.5539999	-13.20600	0	still image
16:48:54	-9.55415	-13.20635	1484	--	--	-9.5539999	-13.20600	0	few corals on broken shhets to lobate flows
16:49:48	-9.55430	-13.20632	1485	172	1.8	-9.5539999	-13.20600	0	we pass the eolngated ridge (this seems to be the contact between jumbled lava and sheets)
16:50:10	-9.55435	-13.20630	1486	--	--	-9.5539999	-13.20600	0	lobate flows, turning south towards Roman City
16:50:30	-9.55432	-13.20630	1486	231	1.6	-9.5539999	-13.20600	0	actually gpoing on a SW course
16:50:43	-9.55437	-13.20633	1486	226	1.6	-9.5539999	-13.20583	0	first pillows appearing
16:51:22	-9.55448	-13.20642	1486	228	1.7	-9.5539999	-13.20583	0	majority is lobate flow, unsedimented but not recent
16:52:18	-9.55453	-13.20652	1486	232	1.5	-9.5539999	-13.20583	0	still image
16:52:36	-9.55458	-13.20652	1486	232	1.5	-9.5541668	-13.20583	0	lobate flows on stage (still image)
16:53:54	-9.55477	-13.20663	1484	230	3.1	-9.5541668	-13.20583	0	jumbled lava, abuzndant broken flows
16:54:58	-9.55487	-13.20672	1482	230	2.6	-9.5541668	-13.20567	0	rough lava surfaces on still image
16:55:00	-9.55487	-13.20672	1482	230	2.7	-9.5541668	-13.20567	0	still image
16:55:02	-9.55487	-13.20672	1482	230	2.7	-9.5541668	-13.20567	0	still image
16:55:54	-9.55488	-13.20675	1482	231	2.4	-9.5541668	-13.20567	0	jumbled lava
16:56:31	-9.55493	-13.20680	1481	230	2.0	-9.5541668	-13.20567	0	jumbled lava
16:57:04	-9.55497	-13.20683	1483	231	1.3	-9.5541668	-13.20567	0	HD ON
16:57:56	-9.55502	-13.20692	1482	231	1.4	-9.5543327	-13.20567	0	HD OFF
16:58:36	-9.55503	-13.20693	1482	231	1.2	-9.5543327	-13.20567	0	still image
16:59:38	-9.55508	-13.20693	1482	231	1.2	-9.5543327	-13.20567	0	lobate flows covering older jumbled flows
17:00:09	-9.55510	-13.20697	1482	231	1.3	-9.5543327	-13.20567	0	lobates are often hollow, draincak abundant
17:00:57	-9.55515	-13.20702	1481	231	1.2	-9.5543327	-13.20567	0	more corals on these lobates
17:01:40	-9.55515	-13.20705	1481	231	1.5	-9.5544996	-13.20583	0	HD ON
17:01:41	-9.55515	-13.20705	1481	231	1.5	-9.5544996	-13.20583	0	HD ON
17:01:59	-9.55513	-13.20705	1481	231	1.9	-9.5544996	-13.20583	0	HD OFF
17:02:02	-9.55513	-13.20705	1481	231	1.7	-9.5544996	-13.20583	0	skylights, collpase of larger areas
17:04:09	-9.55522	-13.20703	1481	222	1.9	-9.5548334	-13.20600	0	still image
17:04:17	-9.55522	-13.20703	1481	222	2.2	-9.5548334	-13.20600	0	large candelabrum (?)
17:06:30	-9.55523	-13.20708	1481	236	2.5	-9.5550003	-13.20617	0	flying over large collpase areas
17:07:14	-9.55530	-13.20715	1482	227	1.6	-9.5551672	-13.20633	0	still image
17:07:50	-9.55533	-13.20717	1483	228	1.5	-9.5551672	-13.20633	0	collpased lobate flows
17:08:29	-9.55543	-13.20723	1483	228	1.4	-9.5553331	-13.20633	0	increasing Fe-staining on lava surfaces
17:08:42	-9.55550	-13.20722	1483	228	1.4	-9.5553331	-13.20633	0	still image
17:09:06	-9.55545	-13.20720	1483	228	1.4	-9.5555	-13.20650	0	HD ON
17:09:38	-9.55547	-13.20722	1483	228	1.4	-9.5555	-13.20650	0	HD OFF
17:09:58	-9.55555	-13.20725	1483	228	1.4	-9.5555	-13.20650	0	bright orange Fe-oxide in interstices
17:11:10	-9.55553	-13.20730	1483	178	1.0	-9.5556669	-13.20650	0	NS fissure in lobate flow; everything drained out; Fe-staining abundant
17:11:17	-9.55553	-13.20730	1483	178	1.0	-9.5556669	-13.20667	0	HD ON
17:11:34	-9.55557	-13.20732	1483	178	0.9	-9.5556669	-13.20667	0	still image
17:11:41	-9.55557	-13.20732	1483	178	1.2	-9.5556669	-13.20667	0	still image
17:12:56	-9.55565	-13.20732	1483	217	1.6	-9.5556669	-13.20667	0	HD OFF
17:14:02	-9.55570	-13.20738	1483	254	1.7	-9.5556669	-13.20667	0	lobate flows, fissure visible in sonar
17:15:37	-9.55580	-13.20753	1485	256	1.2	-9.5556669	-13.20667	0	hacly lava
17:15:46	-9.55580	-13.20753	1485	256	1.2	-9.5556669	-13.20667	0	HD ON
17:16:20	-9.55582	-13.20755	1485	262	1.3	-9.5556669	-13.20667	0	this hackly lava is the collpased roof of a larger lava lake
17:17:33	-9.55585	-13.20757	1485	267	1.4	-9.5556669	-13.20667	0	HD OFF
17:18:47	-9.55585	-13.20757	1483	274	2.7	-9.5558329	-13.20667	0	HD ON
17:19:45	-9.55580	-13.20757	1484	275	2.5	-9.5558329	-13.20667	0	HD OFF
17:21:26	-9.55582	-13.20758	1484	270	1.5	-9.5559998	-13.20683	0	collapse pit
17:23:59	-9.55585	-13.20768	1486	279	1.7	-9.5561666	-13.20700	0	HD ON
17:24:18	-9.55587	-13.20770	1487	270	2.8	-9.5561666	-13.20700	0	still image
17:24:48	-9.55587	-13.20772	1487	201	3.6	-9.5563326	-13.20700	0	massive flow on the other side of the large fissure
17:24:51	-9.55587	-13.20772	1488	201	3.5	-9.5563326	-13.20700	0	still image
17:25:18	-9.55588	-13.20772	1487	219	1.5	-9.5563326	-13.20717	0	angular talus in the fissure
17:25:20	-9.55588	-13.20772	1487	219	1.5	-9.5563326	-13.20717	0	HD OFF
17:25:44	-9.55588	-13.20770	1487	214	3.9	-9.5563326	-13.20717	0	still image
17:29:47	-9.55607	-13.20767	1486	185	3.8	-9.5563326	-13.20717	0	sheet flow, unsedimented
17:29:56	-9.55607	-13.20767	1486	187	3.6	-9.5563326	-13.20717	0	HD ON
17:30:20	-9.55610	-13.20768	1486	187	3.0	-9.5563326	-13.20717	0	HD OFF
17:30:21	-9.55610	-13.20768	1487	187	3.0	-9.5563326	-13.20717	0	whirl in sheet flow surface, sheet is massive and thicker than other seen before
17:30:24	-9.55610	-13.20768	1487	187	2.9	-9.5563326	-13.20717	0	still image
17:31:09	-9.55612	-13.20767	1487	187	3.0	-9.5563326	-13.20717	0	still image
17:36:20	-9.55630	-13.20762	1485	129	6.0	-9.5568333	-13.20700	0	approachin collapse pit (very large)
17:36:49	-9.55632	-13.20762	1489	129	2.8	-9.5570002	-13.20700	0	flying down into the pit (impressive sonar image saved (RR_massive flow3)
17:38:19	-9.55632	-13.20760	1485	128	6.8	-9.5570002	-13.20700	0	HD OFF
17:38:22	-9.55632	-13.20760	1485	129	6.8	-9.5570002	-13.20700	0	HD ON
17:39:21	-9.55633	-13.20760	1484	110	6.6	-9.5571671	-13.20683	0	HD OFF
17:40:53	-9.55628	-13.20758	1485	360	5.4	-9.5571671	-13.20683	0	massive flow also on the eastern side of the fissure
17:45:57	-9.55627	-13.20763	1481	140	9.4	-9.5571671	-13.20683	0	the pit is covered with talus,no hollow parts
17:50:29	-9.55647	-13.20763	1485	173	2.2	-9.5571671	-13.20683	0	leaving the pit, going south along lobate flows
17:52:13	-9.55660	-13.20757	1484	172	2.5	-9.5571671	-13.20683	0	collapse pit

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
17:52:44	-9.55665	-13.20758	1485	173	2.9	-9.5571671	-13.20683	0	the pits are aliogned and follow the ~350 trending axis
17:52:58	-9.55668	-13.20758	1484	173	3.7	-9.5571671	-13.20683	0	still image
17:54:04	-9.55672	-13.20755	1483	244	4.4	-9.5571671	-13.20683	0	talus coming in from the western side (we are flying south)
17:54:25	-9.55672	-13.20755	1483	268	4.6	-9.5571671	-13.20683	0	turning to west and flying towards the western boundary of the fissure
17:55:12	-9.55673	-13.20762	1482	269	2.3	-9.5571671	-13.20683	0	still image
17:56:18	-9.55675	-13.20770	1481	269	1.4	-9.5571671	-13.20683	0	broken lobates, jumbled areas and intact lobates alternating
17:57:16	-9.55677	-13.20782	1479	269	1.7	-9.5571671	-13.20683	0	collapsed lobate flows
17:59:41	-9.55677	-13.20807	1475	269	1.8	-9.5571671	-13.20683	0	HD ON
17:59:45	-9.55677	-13.20807	1475	269	1.9	-9.5571671	-13.20683	0	broken flows
17:59:54	-9.55680	-13.20805	1474	270	1.8	-9.5571671	-13.20683	0	first pillows appear
18:01:21	-9.55682	-13.20810	1471	269	2.3	-9.5571671	-13.20683	0	HD OFF
18:02:33	-9.55683	-13.20810	1471	269	2.8	-9.5571671	-13.20683	0	pilot change
18:05:13	-9.55688	-13.20810	1472	219	3.1	-9.5571671	-13.20683	0	turning south now
18:06:52	-9.55695	-13.20805	1471	187	2.4	-9.5571671	-13.20683	0	Fe oxide in sediment
18:06:59	-9.55695	-13.20805	1471	186	2.4	-9.5571671	-13.20683	0	large pillows
18:07:46	-9.55698	-13.20800	1469	159	3.2	-9.5571671	-13.20683	0	more Fe oxide
18:08:52	-9.55705	-13.20800	1467	169	3.7	-9.5571671	-13.20683	0	still image
18:09:06	-9.55700	-13.20798	1467	169	4.0	-9.5571671	-13.20683	0	fissure,pillow and Fe oxide in still image
18:09:28	-9.55705	-13.20798	1467	169	1.5	-9.5571671	-13.20683	0	sediment in deep fracture
18:09:30	-9.55705	-13.20798	1467	168	1.3	-9.5571671	-13.20683	0	HD ON
18:11:00	-9.55715	-13.20795	1468	169	1.4	-9.5571671	-13.20683	0	HD OFF
18:12:18	-9.55722	-13.20793	1468	135	1.3	-9.5571671	-13.20683	0	turning southeast
18:12:46	-9.55720	-13.20790	1469	112	1.3	-9.5571671	-13.20683	0	we are at the southern end of APE map
18:12:52	-9.55720	-13.20790	1469	110	1.4	-9.5571671	-13.20683	0	turning east
18:12:59	-9.55717	-13.20790	1469	109	1.6	-9.5571671	-13.20683	0	down a gentle hill
18:13:06	-9.55717	-13.20790	1470	109	1.7	-9.5571671	-13.20683	0	pillows
18:14:52	-9.55725	-13.20773	1477	106	1.9	-9.5571671	-13.20683	0	more pillows
18:15:11	-9.55723	-13.20767	1480	107	3.4	-9.5571671	-13.20683	0	slowly moving down 1482m
18:15:25	-9.55728	-13.20763	1482	107	1.6	-9.5571671	-13.20683	0	contact to sheet flows
18:16:01	-9.55725	-13.20753	1483	154	2.2	-9.5571671	-13.20683	0	another crack running N-S
18:16:49	-9.55730	-13.20748	1482	105	2.4	-9.5571671	-13.20683	0	continue east
18:16:58	-9.55727	-13.20747	1483	92	1.4	-9.5571671	-13.20683	0	contact to pillows again
18:17:24	-9.55723	-13.20743	1484	87	2.2	-9.5571671	-13.20683	0	some hydrothermal sediments
18:17:30	-9.55725	-13.20742	1484	87	2.4	-9.5571671	-13.20683	0	Fe oxides
18:18:08	-9.55723	-13.20735	1484	87	2.2	-9.5571671	-13.20683	0	still image
18:18:17	-9.55720	-13.20735	1484	87	2.3	-9.5571671	-13.20683	0	HD ON
18:18:20	-9.55720	-13.20735	1484	87	2.4	-9.5571671	-13.20683	0	thick broken up Fe oxide crusts (still image)
18:18:24	-9.55720	-13.20735	1483	87	2.5	-9.5571671	-13.20683	0	still image
18:18:57	-9.55722	-13.20732	1483	87	2.2	-9.5571671	-13.20683	0	still image
18:19:34	-9.55720	-13.20730	1482	87	1.6	-9.5571671	-13.20683	0	HD OFF
18:19:58	-9.55725	-13.20727	1482	87	1.6	-9.5571671	-13.20683	0	more massive flow followed by pillows
18:20:07	-9.55720	-13.20725	1483	87	2.1	-9.5571671	-13.20683	0	still Fe oxides
18:20:39	-9.55718	-13.20720	1482	87	2.0	-9.5571671	-13.20683	0	more Fe oxides
18:20:41	-9.55718	-13.20720	1482	87	2.0	-9.5571671	-13.20683	0	still image
18:21:00	-9.55718	-13.20717	1482	87	2.2	-9.5571671	-13.20683	0	still image
18:22:30	-9.55713	-13.20717	1482	160	1.4	-9.5571671	-13.20683	0	Fe oxides continue to N and S as far as we can see
18:24:39	-9.55705	-13.20713	1484	260	2.1	-9.5571671	-13.20683	0	lava pillars in detail
18:24:44	-9.55705	-13.20713	1484	250	2.2	-9.5571671	-13.20683	0	still image
18:24:48	-9.55705	-13.20713	1484	250	2.3	-9.5571671	-13.20683	0	HD ON
18:24:58	-9.55703	-13.20717	1484	241	2.3	-9.5571671	-13.20683	0	HD OFF
19:08:22	-9.55710	-13.20712	1482	199	1.8	-9.5571671	-13.20683	0	End of 3d Profil
19:10:00	-9.55713	-13.20715	1481	200	2.4	-9.5571671	-13.20683	0	stop of the 3-D Survey
19:13:58	-9.55712	-13.20692	1483	90	2.7	-9.5571671	-13.20683	0	still image
19:14:17	-9.55710	-13.20693	1483	90	2.5	-9.5571671	-13.20683	0	iron oxide plants
19:15:06	-9.55708	-13.20687	1483	90	2.9	-9.5571671	-13.20683	0	heading to East into the main roman ruins area
19:15:14	-9.55708	-13.20687	1484	90	2.2	-9.5571671	-13.20683	0	still image
19:15:42	-9.55708	-13.20685	1483	105	2.4	-9.5571671	-13.20683	0	fish
19:15:53	-9.55710	-13.20680	1484	94	2.2	-9.5571671	-13.20683	0	HD ON
19:17:00	-9.55708	-13.20682	1483	105	2.9	-9.5571671	-13.20683	0	still image
19:17:21	-9.55710	-13.20682	1483	105	2.8	-9.5571671	-13.20683	0	still image
19:17:30	-9.55710	-13.20682	1483	105	2.9	-9.5571671	-13.20683	0	HD OFF
19:19:16	-9.55700	-13.20663	1481	88	2.9	-9.5571671	-13.20683	0	heading to East
19:19:37	-9.55695	-13.20652	1481	87	2.2	-9.5571671	-13.20683	0	still ruins; collapsed lobes etc.
19:20:40	-9.55695	-13.20640	1481	--	--	-9.5571671	-13.20683	0	iron oxide covers
19:21:12	-9.55687	-13.20630	1480	90	2.5	-9.5571671	-13.20683	0	coral
19:23:39	-9.55682	-13.20642	1479	89	3.7	-9.5571671	-13.20683	0	more jumbled lava now
19:26:29	-9.55705	-13.20663	1482	219	2.7	-9.5571671	-13.20683	0	pillow lava with iron oxide plants
19:26:54	-9.55722	-13.20672	1483	218	1.1	-9.5571671	-13.20683	0	HD ON
19:27:12	-9.55728	-13.20675	1483	221	0.9	-9.5571671	-13.20683	0	large deep in front of us
19:27:35	-9.55727	-13.20675	1484	238	1.2	-9.5571671	-13.20683	0	pillars and lava roofs in the back
19:28:04	-9.55728	-13.20678	1483	238	1.9	-9.5571671	-13.20683	0	still image
19:28:09	-9.55730	-13.20677	1483	238	2.0	-9.5571671	-13.20683	0	shimmering water
19:28:37	-9.55728	-13.20680	1483	--	--	-9.5571671	-13.20683	0	HD OFF
19:28:51	-9.55728	-13.20677	1482	129	3.0	-9.5571671	-13.20683	0	HD ON
19:28:55	-9.55728	-13.20677	1482	124	3.1	-9.5571671	-13.20683	0	still image
19:29:25	-9.55733	-13.20682	1483	95	2.9	-9.5571671	-13.20683	0	turning around and look around
19:30:42	-9.55732	-13.20682	1484	90	1.7	-9.5571671	-13.20683	0	still image
19:31:36	-9.55730	-13.20682	1484	95	1.7	-9.5571671	-13.20683	0	HD OFF
19:32:25	-9.55725	-13.20682	1484	99	1.1	-9.5571671	-13.20683	0	still image
19:35:54	-9.55730	-13.20683	1483	216	2.2	-9.5571671	-13.20683	0	the next wall with drainage structures
19:36:05	-9.55730	-13.20683	1483	216	2.5	-9.5571671	-13.20683	0	jumbled lava
19:36:54	-9.55738	-13.20685	1483	216	2.0	-9.5571671	-13.20683	0	jumbled lava
19:38:04	-9.55757	-13.20697	1483	216	2.9	-9.5571671	-13.20683	0	change from jumbled to pillows

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
19:40:29	-9.55777	-13.20713	1483	187	4.7	-9.5571671	-13.20683	0	graben in front of us; behind a big wall in sonar (running ~east west)
19:41:26	-9.55785	-13.20708	1483	170	3.1	-9.5571671	-13.20683	0	Heading to South, steep wall in front of us
19:42:18	-9.55788	-13.20708	1482	124	4.9	-9.5571671	-13.20683	0	jumbled lava
19:43:54	-9.55797	-13.20697	1483	137	3.5	-9.5585003	-13.20533	0	Seastar
19:43:58	-9.55797	-13.20697	1483	144	3.5	-9.5585003	-13.20533	0	fish
19:44:29	-9.55803	-13.20693	1483	140	2.0	-9.5586672	-13.20533	0	jumbled lava
19:45:01	-9.55812	-13.20683	1483	138	1.3	-9.5586672	-13.20533	0	Seastar
19:45:38	-9.55815	-13.20678	1483	138	1.1	-9.5586672	-13.20533	0	jumbled lava
19:45:55	-9.55818	-13.20678	1482	137	2.1	-9.5586672	-13.20533	0	HD ON
19:46:49	-9.55828	-13.20672	1483	138	1.4	-9.5586672	-13.20533	0	HD OFF
19:48:17	-9.55835	-13.20658	1484	138	0.9	-9.5586672	-13.20533	0	flows with collapsed surface
19:49:58	-9.55855	-13.20635	1484	148	1.1	-9.5588331	-13.20533	0	fish
19:50:20	-9.55865	-13.20627	1484	141	1.1	-9.5588331	-13.20533	0	lobate flow, unsedimented
19:51:00	-9.55877	-13.20617	1486	179	1.4	-9.5588331	-13.20533	0	jumbled lava
19:51:33	-9.55892	-13.20620	1484	180	3.1	-9.5588331	-13.20533	0	nice position how the jumbled lava is produced
19:52:27	-9.55885	-13.20615	1485	180	1.4	-9.5588331	-13.20533	0	HD ON
19:54:18	-9.55883	-13.20617	1484	185	2.3	-9.5588331	-13.20533	0	HD OFF
19:56:06	-9.55888	-13.20617	1486	181	0.8	-9.5588331	-13.20533	0	HD OFF
19:56:56	-9.55902	-13.20615	1486	181	1.0	-9.5588331	-13.20533	0	jumbled lava
19:58:06	-9.55917	-13.20617	1486	202	1.4	-9.559	-13.20533	0	HD ON
19:58:17	-9.55915	-13.20615	1486	212	1.6	-9.559	-13.20533	0	another ruin spot
19:58:45	-9.55915	-13.20612	1486	234	1.5	-9.559	-13.20533	0	HD OFF
19:58:47	-9.55917	-13.20612	1486	235	1.5	-9.559	-13.20533	0	still image
19:59:09	-9.55917	-13.20613	1485	193	2.0	-9.5591669	-13.20533	0	heading South
20:01:40	-9.55943	-13.20612	1485	180	1.1	-9.5593328	-13.20533	0	lobate flow, unsedimented
20:02:07	-9.55950	-13.20608	1486	181	0.3	-9.5593328	-13.20533	0	another collapsed dome
20:02:24	-9.55952	-13.20607	1486	181	0.3	-9.5593328	-13.20533	0	still image
20:02:38	-9.55950	-13.20608	1486	181	0.3	-9.5593328	-13.20533	0	HD ON
20:03:20	-9.55952	-13.20608	1486	180	0.4	-9.5594997	-13.20533	0	HD OFF
20:03:54	-9.55957	-13.20607	1485	180	1.2	-9.5594997	-13.20533	0	heading South above lobate flows, some collapsed
20:06:02	-9.55972	-13.20607	1486	209	0.3	-9.5596666	-13.20533	0	another collapsed dome
20:06:18	-9.55973	-13.20605	1486	223	0.3	-9.5596666	-13.20533	0	still image
20:07:06	-9.55973	-13.20603	1485	169	1.0	-9.5598326	-13.20533	0	heading south
20:07:13	-9.55975	-13.20603	1485	169	0.7	-9.5598326	-13.20533	0	corals on a tube
20:07:29	-9.55977	-13.20602	1485	141	0.9	-9.5598326	-13.20533	0	still image
20:07:31	-9.55977	-13.20602	1485	141	0.9	-9.5598326	-13.20533	0	still image
20:07:39	-9.55977	-13.20602	1485	127	0.7	-9.5598326	-13.20533	0	HD ON
20:08:10	-9.55977	-13.20605	1486	116	0.4	-9.5598326	-13.20533	0	still image
20:08:12	-9.55977	-13.20605	1485	116	0.5	-9.5598326	-13.20533	0	HD OFF
20:09:11	-9.55988	-13.20598	1486	178	0.9	-9.5600004	-13.20533	0	HD ON
20:09:22	-9.55990	-13.20597	1485	182	1.1	-9.5600004	-13.20533	0	fish
20:10:53	-9.56000	-13.20600	1485	185	2.2	-9.5600004	-13.20533	0	HD OFF
20:11:14	-9.56002	-13.20598	1485	194	1.0	-9.5600004	-13.20533	0	perfect roman ruis
20:11:31	-9.56005	-13.20598	1485	198	1.6	-9.5601673	-13.20533	0	main street of Pompeji
20:13:55	-9.56027	-13.20598	1485	168	2.4	-9.5601673	-13.20533	0	still on "main street": collapsed flow with drainage structures
20:15:58	-9.56048	-13.20597	1486	176	1.0	-9.5603333	-13.20533	0	structure changes, jubled to hackley
20:18:00	-9.56072	-13.20595	1483	177	1.6	-9.5605001	-13.20533	0	jumbled lava
20:18:22	-9.56080	-13.20592	1482	186	2.4	-9.5605001	-13.20533	0	jumbled lava
20:18:49	-9.56088	-13.20593	1482	196	2.3	-9.560667	-13.20533	0	before us a rupture East/West
20:19:07	-9.56093	-13.20595	1482	219	2.5	-9.560667	-13.20533	0	sheet flow, slightly sedimented
20:19:31	-9.56100	-13.20602	1482	221	2.1	-9.560667	-13.20533	0	mix of sheet flow and jumbled
20:19:45	-9.56107	-13.20605	1482	235	1.4	-9.560667	-13.20533	0	lobate flow, slightly sedimented
20:19:59	-9.56107	-13.20605	1481	249	1.6	-9.560667	-13.20533	0	turn to West
20:23:37	-9.56148	-13.20685	1472	253	1.8	-9.5609999	-13.20533	0	mix of jubled and lobate lava, still slightly sedimented
20:24:15	-9.56157	-13.20700	1471	254	2.8	-9.5611668	-13.20550	0	a rupture North/South
20:24:28	-9.56155	-13.20700	1469	254	4.0	-9.5611668	-13.20550	0	many blocks with corals
20:25:53	-9.56155	-13.20713	1471	254	2.2	-9.5613327	-13.20550	0	now more pillows, lobates
20:28:15	-9.56160	-13.20742	1473	254	2.5	-9.5616674	-13.20583	0	fat pillows
20:28:21	-9.56160	-13.20742	1474	254	2.3	-9.5616674	-13.20583	0	pillow lava, slightly sedimented
20:29:14	-9.56168	-13.20757	1474	255	3.2	-9.5618334	-13.20600	0	lobate flow, slightly sedimented
20:30:20	-9.56172	-13.20767	1475	256	2.8	-9.5618334	-13.20617	0	pillow lava, slightly sedimented
20:33:27	-9.56198	-13.20798	1475	255	4.3	-9.5623331	-13.20667	0	still image
20:33:42	-9.56195	-13.20800	1476	255	3.4	-9.5623331	-13.20667	0	HD ON
20:34:14	-9.56200	-13.20800	1476	255	3.5	-9.5623331	-13.20667	0	HD OFF
20:34:22	-9.56197	-13.20802	1476	257	3.9	-9.5623331	-13.20667	0	nice coral assemblages
20:34:27	-9.56197	-13.20802	1476	256	4.0	-9.5623331	-13.20667	0	still image
20:36:12	-9.56212	-13.20827	1476	256	3.7	-9.5625	-13.20700	0	pillow lava, slightly sedimented
20:36:25	-9.56215	-13.20830	1472	255	7.0	-9.5626669	-13.20700	0	still heading to SW
20:37:02	-9.56218	-13.20840	1466	255	5.5	-9.5626669	-13.20717	0	climbing up a hill made of pillows and tube
20:38:04	-9.56227	-13.20855	1459	247	4.9	-9.5628328	-13.20717	0	turn South again
20:39:49	-9.56258	-13.20843	1467	183	4.5	-9.5629997	-13.20750	0	pillow lava, slightly sedimented
20:40:25	-9.56272	-13.20842	1463	181	6.3	-9.5629997	-13.20750	0	still image
20:40:34	-9.56270	-13.20838	1463	184	5.4	-9.5629997	-13.20750	0	foto from pillows
20:41:41	-9.56277	-13.20825	1460	147	4.1	-9.5629997	-13.20750	0	heading along the flank of the ridge
20:41:56	-9.56282	-13.20823	1460	147	3.5	-9.5629997	-13.20767	0	heading to SE
20:43:07	-9.56287	-13.20808	1459	147	5.0	-9.5631666	-13.20767	0	still image
20:43:10	-9.56287	-13.20808	1458	147	4.9	-9.5631666	-13.20767	0	HD ON
20:44:08	-9.56288	-13.20803	1458	147	4.4	-9.5631666	-13.20767	0	HD OFF
20:44:22	-9.56292	-13.20802	1459	141	3.7	-9.5631666	-13.20767	0	tubes hanging down along the slope
20:45:58	-9.56295	-13.20785	1470	118	2.5	-9.5631666	-13.20767	0	heading downhill to SE
20:46:55	-9.56295	-13.20772	1473	118	3.7	-9.5633326	-13.20767	0	pillow lava, unsedimented
20:47:32	-9.56297	-13.20763	1474	118	3.3	-9.5633326	-13.20767	0	pillow lava, unsedimented
20:49:12	-9.56300	-13.20735	1469	119	5.7	-9.5635004	-13.20750	0	pillow lava, unsedimented
20:49:40	-9.56297	-13.20737	1471	117	3.7	-9.5635004	-13.20733	0	change to jumbled stuff

UTC Time	ROV Lat	ROV Lon	ROV Depth	ROV Heading	ROV Altitude	Ship Lat	Ship Lon	Water Depth	Comment
20:52:09	-9.56305	-13.20712	1469	--	--	-9.5638332	-13.20717	0	pillar; collapsed lava pond
20:52:42	-9.56312	-13.20705	1468	116	5.3	-9.5638332	-13.20717	0	sheet flow, slightly sedimented
20:53:36	-9.56318	-13.20695	1470	114	3.6	-9.5638332	-13.20717	0	lobes at the top, partly collapsed
20:54:31	-9.56323	-13.20683	1468	127	3.5	-9.5638332	-13.20700	0	still image
20:55:00	-9.56323	-13.20682	1468	126	2.9	-9.5638332	-13.20700	0	lobate flow, slightly sedimented
20:55:30	-9.56327	-13.20677	1468	127	3.0	-9.5638332	-13.20683	0	some lobes are broken, displaying drainage structure
20:55:47	-9.56332	-13.20672	1467	126	3.0	-9.5638332	-13.20683	0	still heading to SE
20:56:18	-9.56333	-13.20667	1468	126	1.6	-9.5638332	-13.20667	0	lobate flow, slightly sedimented
20:56:37	-9.56335	-13.20665	1467	125	2.3	-9.5640001	-13.20667	0	some iron oxides in the interstices
20:56:43	-9.56338	-13.20662	1466	125	2.5	-9.5638332	-13.20667	0	jumbled lava
20:57:59	-9.56338	-13.20648	1466	122	2.1	-9.5640001	-13.20633	0	jumbled lava
20:59:22	-9.56340	-13.20640	1465	128	2.2	-9.5640001	-13.20617	0	lobate flow, unsedimented
21:00:19	-9.56347	-13.20630	1464	127	1.9	-9.5640001	-13.20600	0	lobate flow, slightly sedimented
21:02:52	-9.56352	-13.20605	1462	132	2.1	-9.564167	-13.20583	0	lobate flow, slightly sedimented
21:03:29	-9.56352	-13.20603	1463	132	1.9	-9.564167	-13.20583	0	still heading SE
21:05:05	-9.56350	-13.20600	1462	132	2.0	-9.564333	-13.20567	0	lobate flow, slightly sedimented
21:05:05	-9.56350	-13.20600	1462	132	2.0	-9.564333	-13.20567	0	lobate flow, slightly sedimented
21:05:36	-9.56355	-13.20592	1462	133	2.3	-9.564333	-13.20567	0	still image
21:05:36	-9.56355	-13.20592	1462	133	2.3	-9.564333	-13.20567	0	still image
21:07:23	-9.55955	-13.20345	1461	132	2.3	-9.564333	-13.20550	0	pillow lava, unsedimented
21:08:13	-9.56370	-13.20563	1460	132	2.0	-9.5644999	-13.20533	0	still image
21:08:49	-9.56373	-13.20557	1459	136	1.9	-9.5644999	-13.20533	0	pillow lava, unsedimented
21:09:39	-9.56378	-13.20550	1458	128	2.1	-9.5644999	-13.20517	0	lobate flow, unsedimented
21:10:24	-9.56383	-13.20542	1455	139	2.5	-9.5644999	-13.20500	0	heading SE
21:10:31	-9.56383	-13.20540	1454	138	2.6	-9.5644999	-13.20500	0	mega pillows
21:12:30	-9.56403	-13.20522	1452	137	1.5	-9.5646667	-13.20500	0	climbing up a pillow mound
21:13:09	-9.56413	-13.20518	1450	139	2.5	-9.5646667	-13.20500	0	fault zone ahead
21:13:21	-9.56413	-13.20515	1450	139	2.5	-9.5646667	-13.20500	0	still image
21:14:41	-9.56420	-13.20510	1447	163	4.3	-9.5646667	-13.20500	0	foto from the fault zone
21:14:49	-9.56420	-13.20512	1446	160	6.4	-9.5646667	-13.20500	0	steep wall in fron of us
21:15:21	-9.56428	-13.20508	1445	158	2.9	-9.5646667	-13.20500	0	fissure heading NS
21:16:32	-9.56430	-13.20505	1445	129	3.0	-9.5646667	-13.20483	0	at the top, the pillows are strongly faulted/broken
21:16:52	-9.56433	-13.20503	1444	135	2.4	-9.5646667	-13.20483	0	heading SE
21:18:26	-9.56433	-13.20477	1444	89	4.8	-9.5646667	-13.20483	0	change heading to W to leave the hill directly into the valley east of the hill
21:19:37	-9.56422	-13.20455	1446	98	2.7	-9.5646667	-13.20483	0	pillow lava, unsedimented
21:19:57	-9.56420	-13.20452	1447	98	2.5	-9.5646667	-13.20483	0	corals
21:21:24	-9.56420	-13.20438	1448	93	2.5	-9.5646667	-13.20483	0	pillow lava, unsedimented
21:24:39	-9.56415	-13.20403	1451	108	3.5	-9.5646667	-13.20450	0	pillow lava, unsedimented
21:24:39	-9.56415	-13.20403	1451	108	3.5	-9.5646667	-13.20450	0	pillow lava, unsedimented
21:25:09	-9.56415	-13.20402	1452	116	2.2	-9.5646667	-13.20433	0	still image
21:25:25	-9.56413	-13.20402	1451	105	3.5	-9.5646667	-13.20433	0	foto with tannenbaum and fish
21:25:38	-9.56412	-13.20400	1451	100	3.0	-9.5646667	-13.20433	0	heading W
21:25:48	-9.56412	-13.20395	1451	100	3.1	-9.5646667	-13.20433	0	pillow lava, unsedimented
21:26:44	-9.56412	-13.20385	1454	113	1.3	-9.5646667	-13.20417	0	large lava tubes
21:28:42	-9.56408	-13.20358	1457	--	--	-9.5646667	-13.20383	0	still image
21:29:14	-9.56412	-13.20360	1457	95	2.9	-9.5646667	-13.20367	0	foto from pillow lying in scrambled lava
21:29:53	-9.56407	-13.20352	1460	92	1.4	-9.5646667	-13.20367	0	jumbled lava
21:30:13	-9.56408	-13.20350	1459	92	3.6	-9.5646667	-13.20350	0	changes to lobate; foto of this
21:30:14	-9.56408	-13.20350	1459	92	3.8	-9.5646667	-13.20350	0	still image
21:30:33	-9.56408	-13.20345	1462	92	2.3	-9.5646667	-13.20350	0	lobate flow, slightly sedimented
21:30:55	-9.56407	-13.20337	1461	92	5.1	-9.5646667	-13.20350	0	jumbled lava
21:33:18	-9.56398	-13.20317	1466	97	3.2	-9.5646667	-13.20300	0	entering the valley
21:33:25	-9.56400	-13.20315	1467	98	2.0	-9.5646667	-13.20300	0	pillow lava, < 50% sediment
21:34:22	-9.56400	-13.20303	1467	--	--	-9.5646667	-13.20283	0	still image
21:34:58	-9.56397	-13.20307	1467	84	4.6	-9.5646667	-13.20283	0	large blocks, faulting zone
21:35:32	-9.56395	-13.20297	1466	91	3.8	-9.5646667	-13.20267	0	valley in front of us shows sediments
21:36:07	-9.56393	-13.20295	1467	101	3.6	-9.5646667	-13.20267	0	block of sheetflow
21:36:12	-9.56393	-13.20295	1467	99	3.5	-9.5646667	-13.20267	0	still image
21:37:22	-9.56392	-13.20282	1468	97	3.6	-9.5646667	-13.20250	0	pillow lava, slightly sedimented
21:37:51	-9.56392	-13.20277	1470	107	2.9	-9.5646667	-13.20250	0	lobate flow, slightly sedimented
21:38:22	-9.56395	-13.20272	1473	110	2.5	-9.5646667	-13.20233	0	jumbled lava
21:38:31	-9.56395	-13.20268	1473	109	2.0	-9.5646667	-13.20233	0	still image
21:38:48	-9.56397	-13.20263	1473	108	2.2	-9.5646667	-13.20233	0	jumbled lava squeezed together
21:39:31	-9.56402	-13.20257	1474	110	1.7	-9.5646667	-13.20233	0	jumbled lava
21:40:27	-9.56407	-13.20247	1474	116	2.0	-9.5646667	-13.20217	0	still image
21:40:46	-9.56410	-13.20243	1473	113	2.1	-9.5646667	-13.20217	0	large area covered with jumbled lava
21:40:58	-9.56412	-13.20238	1473	114	2.6	-9.5646667	-13.20217	0	still image
21:41:40	-9.56412	-13.20232	1473	112	1.8	-9.5646667	-13.20217	0	HD ON
21:41:49	-9.56415	-13.20230	1473	113	1.9	-9.5646667	-13.20217	0	jumbled lava
21:42:04	-9.56413	-13.20233	1473	114	1.8	-9.5646667	-13.20217	0	Federstern
21:42:06	-9.56413	-13.20233	1473	116	1.8	-9.5646667	-13.20217	0	HD OFF
21:43:14	-9.56412	-13.20227	1473	123	1.7	-9.5646667	-13.20200	0	still image
21:43:54	-9.56410	-13.20218	1474	111	2.4	-9.5646667	-13.20200	0	heading to W: sedimented valley
21:44:19	-9.56408	-13.20208	1476	101	1.3	-9.5646667	-13.20217	0	pillow lava, < 50% sediment
21:45:27	-9.56415	-13.20208	1476	102	1.5	-9.5646667	-13.20200	0	HD ON
21:45:40	-9.56417	-13.20208	1476	102	1.4	-9.5646667	-13.20200	0	still image
21:45:57	-9.56415	-13.20210	1476	103	1.3	-9.5646667	-13.20200	0	HD OFF
21:46:13	-9.56417	-13.20208	1475	103	2.3	-9.5646667	-13.20200	0	pillows obviously with Mn crust
21:46:25	-9.56413	-13.20210	1470	91	7.4	-9.5646667	-13.20200	0	OFF THE BOTTOM
21:46:39	-9.56413	-13.20210	1464	326	13.1	-9.5646667	-13.20200	0	HD ON
21:46:43	-9.56417	-13.20215	1463	324	14.3	-9.5646667	-13.20200	0	HD OFF
21:47:11	-9.56412	-13.20217	1464	336	10.9	-9.5646667	-13.20200	0	HD ON
21:47:35	-9.56405	-13.20220	1465	282	11.1	-9.5646667	-13.20200	0	shark
21:47:51	-9.56400	-13.20218	1464	219	11.7	-9.5646667	-13.20183	0	HD OFF
22:45:04	0.00000	0.00000	11	--	--	-9.5646667	-13.20167	0	ON DECK

Appendix: Rock Sampling Protocol M78/2: Inside Corner High at 5°S

Cruise: MAR SOUTH V
Date: 24.04.2009
Station: M78-2_310ROV
Targets: Sampling the uppermost part of the Inside Corner High at 5° South

Initial Ship Position: Lat: -5.1020002 S; Lon: -11.6864996 W
Initial Water Depth: 1483.7 meter

UTC Time	ROV Lat	ROV Lon	Ship Depth	Comment
12:31:06	11°41.190'W	5°06.120 S	1483.7	ROV in water
13:11:43	11°41.080W	5°06.090 S	1515.8	ROV on bottom
21:45:21	11°41.430W	5°05.900 S	1456.6	ROV off bottom
22:36:34	11°41.410W	5°05.920 S		ROV on deck

Sample-no	UTC Time ROV Lat ROV Lon ROV Depth	Size (cmxcmxcm)	Weight (kg)	Description
310ROV-1	14:02:32 -5.1006665 -11.6858 1557.9	7x7x7	1	**Tectonized microgabbro** phacoidal shape (Fig. 1); sheared surface with striations; contains domains which seems unstrained; altered to greenschist facies
310ROV-2	14:30:41 -5.0995831 -11.686183 1546.0	10x5x3	0.7	**Serpentinite** sheared surface with striations; dense greenish rock; strongly foliated and internally sherard; formation of micro-phacoids (Fig. 2) no relics of peridotite minerals
310ROV-3	14:53:23 -5.0995169 -11.686216 1546.1	4x4x2	0.3	**Serpentinite breccia** phacoidal shape; strongly sheared surface with striations (Fig. 3); matrix: greenish black dense serpentinite; components: extremely finegrained angular clasts probalbly amphibolitic ultramylonite, now in greenschist facies
310ROV-4	15:18:05 -5.0984001 -11.686033 1567.8	7x7x5	0.7	**Amphibolitic ultramylonite** sheared surface; strongly sheared, foliated, dense dark rock; probably primary amphibolitic and altered to greenschist facies
310ROV-5	15:35:57 -5.0978498 -11.686133 1523.7	5x4x2	0.3	**Serpentinite-talc schist** sheared surface with striations; whitish-green, strongly foliated; no relics of peridotite minerals visible
310ROV-6	16:01:01 -5.0975833 -11.687067 1510.8	10x8x5	1	**Sheared peridotite** sheared surface; black-green; ~ 90% serpentinized; relics of mm-sized opx swimming in serpentine matrix; mm-sized roundish olivines completely altered to serpentinite with mesh structure; probably former porphyroclastic texture

Sample-no	UTC Time ROV Lat ROV Lon ROV Depth	Size (cmxcmxcm)	Weight (kg)	Description
310ROV-7	16:18:41 -5.0972166 -11.687 1557.6	4x3x3	0.1	**Tectonic mafic breccia**extremely tectonized rock representing probably tectonic breccia; dense, dark matrix and clasts correspond probably to former mafic ultramylonites; now altered to greenschist facies
310ROV-8	16:48:11 -5.0970998 -11.686967 1564.3	8x4x4	1	**Serpentinite** sheared surface with striations; black-green; well-preserved porphyroclastic texture; tectonized, but not strongly foliated; mm-sized opx now pseudomorphosed to serprentine (bastite); olivines completely altered to serpentinite with mesh structure
310ROV-9	17:20:17 -5.0968332 -11.6873 1520.6	10x5x5	0.8	**Serpentinite-talc schist** extremely sheared surface with striations; sample has shape of a phacoid (Fig. 4); internally extremely shared; greenish-wihte dense serpentine mass without any peridotite relic visible
310ROV-10	17:45:13 -5.0965834 -11.6875 1505.0	10x5x3	0.8	**Amphibolitic ultramylonite** extremely sheared surface with striations and corrugations (Fig. 5); dense, laminated, mafic, greenish-black rock; strongly deformed; probably ultramylonite; probably primary amphibolitic and altered to greenschist facies
310ROV-11	18:48:34 -5.0957665 -11.687616 1539.4	6x6x5	0.8	**Finegrained gabbro** sheared surface; now in greenschist facies; probably talc on the surface; extremely teconized; initial stadium of brecciation; still domains visible which seems unstrained
310ROV-12	19:22:17 -5.0956168 -11.687817 1492.5	20x10x10	5	**Serpentinite** sheared surface with striations; black-green; strongly foliated, massive serpentine without any peridotite relic visible; development of cm-sized asbestos aggregates on the surface (Fig. 6); formation of mm- to cm-sized phacoidal shear bodies within the sample (Fig. 7)
310ROV-13	19:43:35 -5.0954666 -11.687783 1475.9	8x5x3	0.5	**Amphibolitic ultramylonite** sheared surface with striations; dense, mafic, greenish rock; strongly tectonized and foliated; probably ultramylonite; probably primary amphibolitic and altered to greenschist-facies; fibrous aggregates of tremolite/actionlite
310ROV-14	20:15:22 -5.0960331 -11.688467 1496.4	5x5x4	0.7	**Serpentinite** sheared surface with striations; black-green; tectonized; few relics of mm-sized opx are visible, not clear whether they are pseudomorphs of serpentine; development of mm-sized sher zones made of serpentine
310ROV-15	20:40:23 -5.0969834 -11.688916 1505.0	14x5x5	2	**Serpentinite breccia** cm-sized, angular, elongated, strongly sheared serpentinite clasts with smooth surfaces (asbestous aggregates?), surrounded by a black dense matrix of serpentine (Fig. 8)

Sample-no	UTC Time ROV Lat ROV Lon ROV Depth	Size (cmxcmxcm)	Weight (kg)	Description
310ROV-16	21:07:35 -5.0980334 -11.690367 1459.0	15x10x8	3	**Tectonized serpentinite** strongly sheared surface with striations; extremely tectonized (Fig. 9); dense greenish-black rock with some domains showing dark-white spotty features eventually representing former gabbro texture (microgabbro); the whole rock corresponds eventually to a tectonic mixture of serpentinite and gabbro
310ROV-17	21:42:30 -5.0981998 -11.691484 1416.1	10x7x4	2	**Sheared peridotite**strongly sheared surface with striations; rock shows foliation; former peridotite with porphyroclastic texture, now altered to serpentinite; relics of mm-sized opx augen; olivine altered to serpentinite with mesh structure (Fig. 10)

Fig. 1. Sample 310ROV-1. Tecotonized microgabbro with phacoidal shape; note the stronlgy sheared, smooth suface.

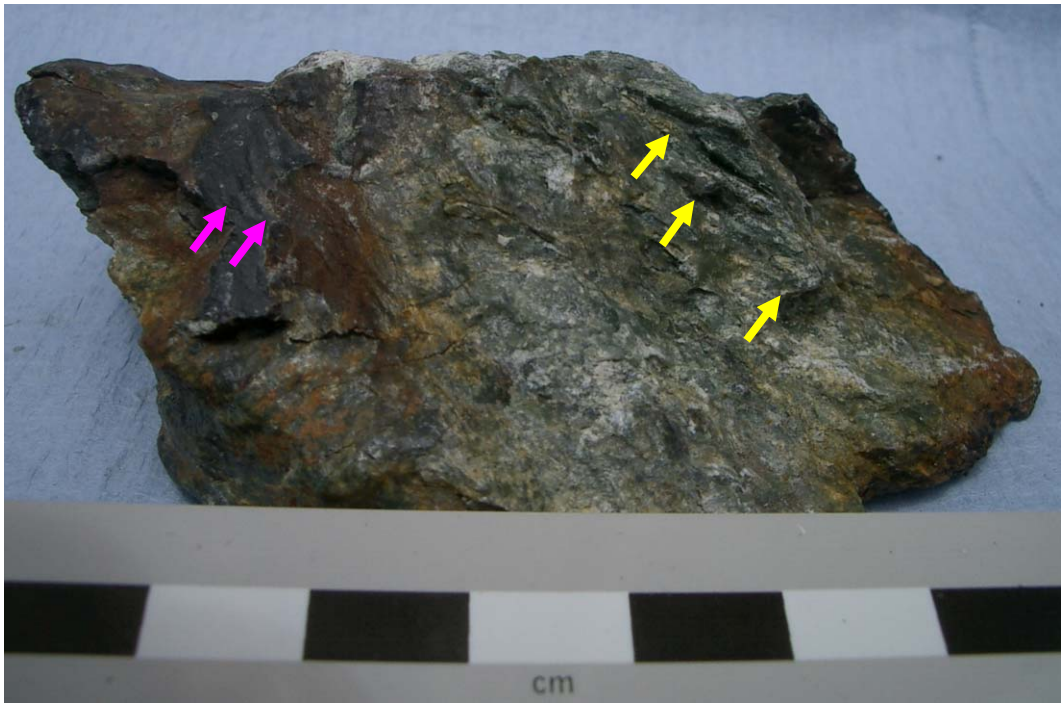

Fig. 2. Sample 310ROV-2. Serpentinite; strongly foliated and internally sherard; note the formation of micro-phacoids (yellow arrows) with orientation along the striations visible on the surface of the rock (pink arraows)

Fig. 3. Sample 310ROV-3. Serpentinite breccia with phacoidal shape; strongly sheared surface with striations (yellow arrows); sample contains angular clasts of amphibolitic ultramylonite

Fig. 4. Sample 310ROV-9. Serpentinite-talc schist; extremely sheared surface with striations; note that the whole sample correspond to a typical phacoid, which are visible also in the outcrop

Fig. 5. Sample 310ROV-10. Amphibolitic ultramylonite; rock is extremely tectonized; sheared surface with striations and corrugations (arrows), subparallel to the foliation of the rock, implying intense shear processes

Fig. 6. Sample 310ROV-12. Sheared Serpentinite; sheared surface with striations; development of cm-sized asbestos aggregates on the surface, indicating strong shear forces at the surface

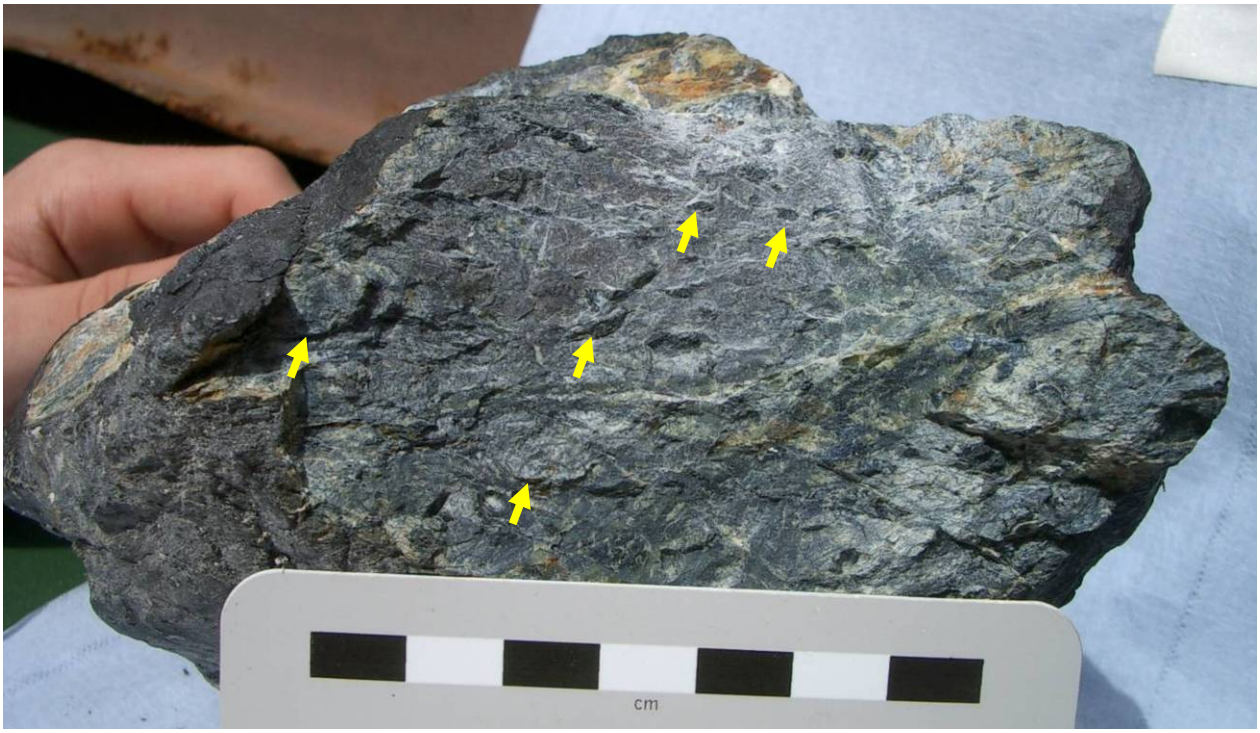

Fig. 7. Sample 310ROV-12. Sheared Serpentinite; strong internal deformation; visible is the formation of mm- to cm-sized phacoidal shear bodies within the sample (arrows)

Fig. 8. Sample 310ROV-15. Serpentinite breccia; visible are cm-sized, angular, elongated, strongly sheared clasts of probably asbestous aggregates, surrounded by a black dense matrix of serpentine

Fig. 9. Sample 310ROV-16. Tectonized serpentinite; strongly sheared surface with striations, foliation (marked by an arrow) of the rock is subparallel to the striations; rock is extremely tectonized

Fig. 10. Sample 310ROV-17. Sheared peridotite, now altered to serpentinite; visible are relics of mm- to cm-sized orthopyroxene augen (yellow arrows) surrounded by sheared serpentine bands

APPENDIX for 2.4.5 Fluid Chemistry

Kiel Pumping System (KIPS)

One pre-requisite for an accurate estimate of the composition of hydrothermal fluids venting from high-temperature black smokers or from diffuse mussel-field sites is sampling of the hydrothermal fluids without entrainment of ambient seawater that would lead to immediate precipitation of sulphides, anhydrite and barite and, hence, loss of these compounds from solution. One measure of the purity of the sampled hydrothermal fluid is the fluid temperature. Consequently, real-time *in-situ* measurement of the temperature helps to guide the tip of the sampling nozzle to the hottest region within the vent orifice where the purity of the venting fluid is highest and least diluted with seawater. Another pre-requisite is that all materials coming into contact with the sampled fluid are inert and have lowest adsorption coefficients preventing systematic errors introduced by either contamination or losses due to adsorption. Precipitation during cooling of the sampled fluid, however, cannot completely be avoided, but transparency and the smooth surfaces of PFA allow a quantitative recovery of particles from the sample flasks. The Kiel Pumping System (KIPS-3) is a remotely controlled flow-through system mounted on the ROV's starboard tool sled (Garbe-Schönberg et al., 2006). The parts of the system getting into contact with the sample are entirely made of inert materials and withstand temperatures up to 260 °C (short-term 305 °C): perfluoralkoxy (PFA), polyetheretherketone (PEEK), polytetrafluorethylene (PTFE, Teflon®), and a short tube of high-purity titanium (99.9 % Ti). Fluid enters via this titanium tube (40 cm length, 6 mm I.D., bent to 45°) - the nozzle – inserted into a stainless steel protection tube and mounted to a T-handle that is guided by the ROV's ORION manipulator arm (Fig. 1, 2a, b). Parallel to the titanium nozzle is a high-temperature sensor (see below) delivering real-time temperature data for the tip of the nozzle. Coiled PFA tubing (3/8" O.D., 3 m length) connects the nozzle to a remotely controlled multi-port valve (PEEK/ PTFE) delivering the fluid to the respective sampling flask. The valve is driven by a stepper motor (electric actuator, Schilling Robotics, U.S.A.) and controlled from a separate laptop via RS232 tunneling through the ROV control system (Kiel 6000 ROV: Node 6, port #14). The software package used was FluidCtrl V. 3.0.0 by Jens Renken @ Marum Soft, Bremen.

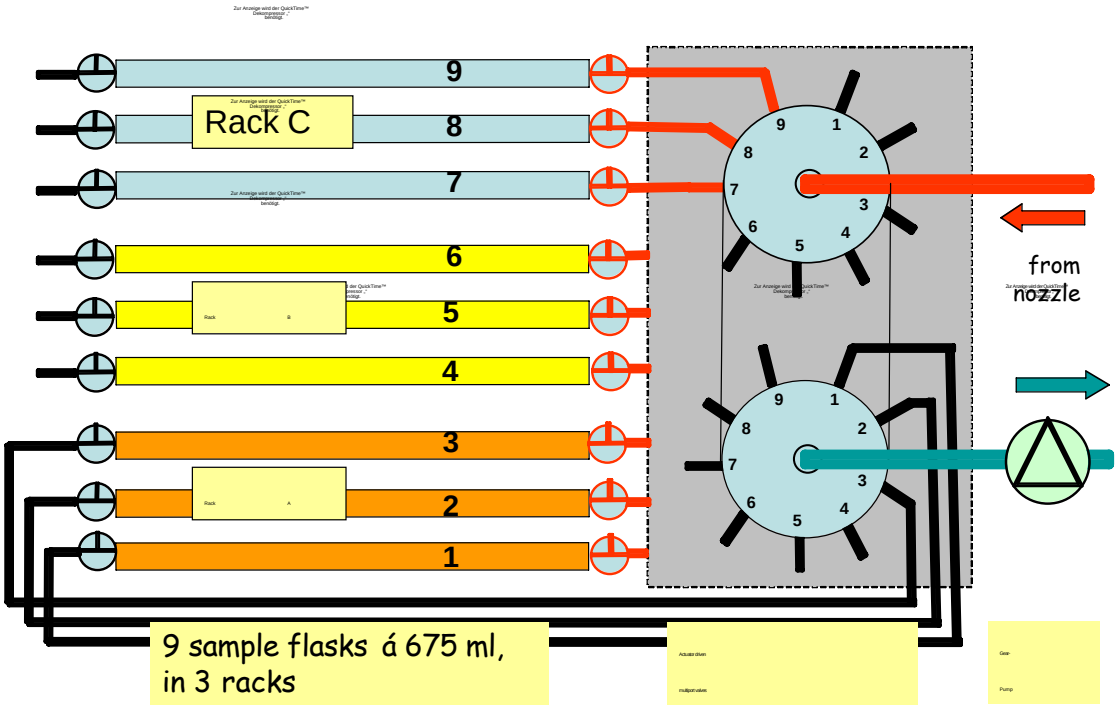

Fig. 1: Schematic configuration of the inert KIPS fluid sampling system (only tubing connections to flasks # 1 - # 3 are shown for clarity). Fluid entering the nozzle is distributed by a motorized multiport-synchro-valve into 9 PFA sample flasks á 675 ml. The gear pump is positioned downstream. Racks A, B, C with 3 flasks each can be quickly removed and sub-sampled in the lab. An additional peristaltic pump delivers dissolved reagents for *in-situ* fixation (e.g., ZnAc for dissolved sulfide) of 1-3 samples.

The multiport synchro-valve has 9 inlet and 9 outlet ports connected to 9 PFA flasks with 675 ml volume each (Savillex, USA). Each bottle is equipped with stopcocks. The flasks are mounted in three racks A-C, with every rack containing three horizontally positioned bottles (A1-A3, B4-B6, C7-C9), allowing an easy transfer of the racks to the laboratory where sub-sampling was done. Flasks were pre-filled with ambient bottom seawater (Atlantic Deep Water, ADW) obtained from previous CTD hydrocasts. A 24 V deep sea mechanical gear-pump, switched on and off through the ROV's telemetrie, is mounted downstream to the sample flasks, thus, avoiding contamination of the samples. The pumping rate was approx. 1 L/min at 24 VDC. The standard pumping time per sample was set to 4 min. making sure that the flask volume was exchanged at least 5 times. The outlet of the KIPS system is located on the porch at the front-side of the ROV, where video control allows the observation of warm shimmering fluids leaving the system. In addition, a flow mobile was attached to the outlet tube at diffuse vent sites.

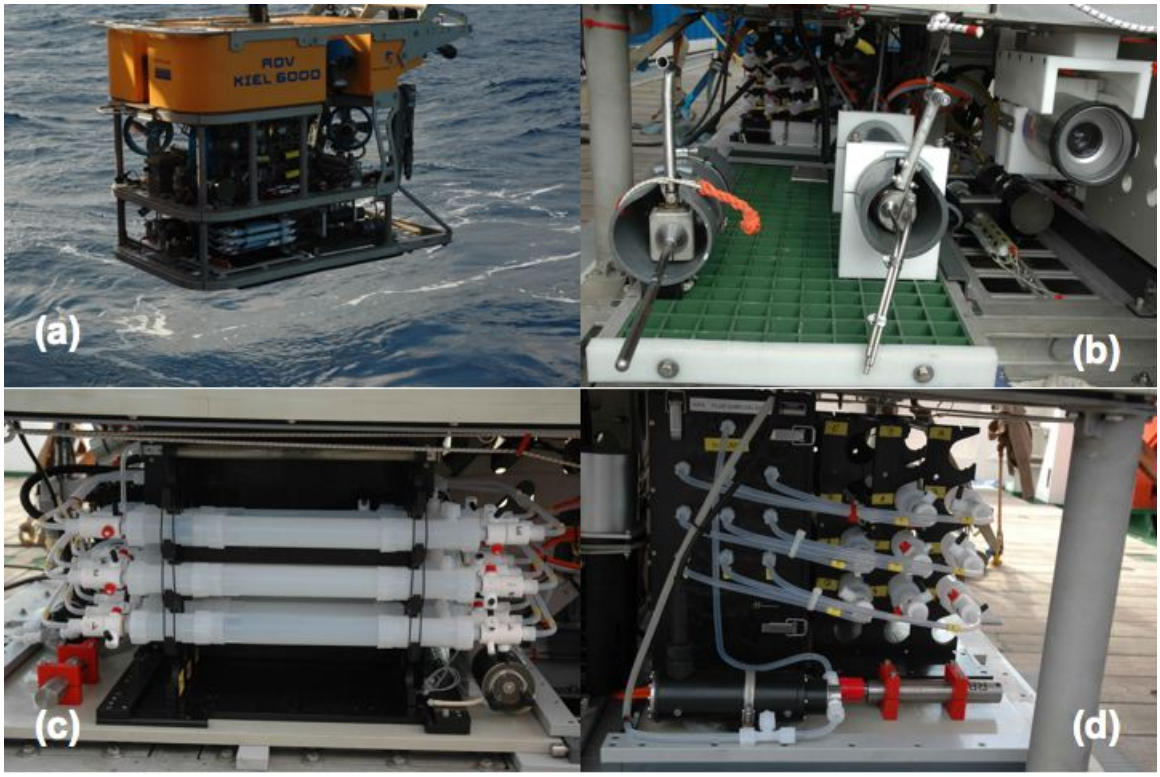

Fig. 2: (a) KIPS-3 mounted on the tool sled of ROV KIEL6000. (b) T-Handle with KIPS titanium nozzle, temperature probe, and ISMS titanium tube, all bent to 45°. To the left is the 8-channel T probe, to the right the HD video camera. (c) PFA sample flasks with stopcocks, mounted in 3 racks A-C; temperature data logger (left) and peristaltic pump (right). (d) Side view with connecting tubing between multiport synchro-valve housing and sample flasks. Mechanical gear pump (black, left) and temperature data logger (right).

A high-precision temperature probe (manufactured by H.-H. Gennerich, Bremen) in stainless steel pressure housing was attached parallel to the titanium nozzle (Fig. 2b). The probe is equipped with both a Pt-1000 and a NTC thermistor sensor mounted adjacent to each other. The two temperature sensors are characterized by opposite resistivity-temperature relationships. The 90% time constant of both sensors in water is better than 10 s. The probe is connected to a RBR logger TBR-2050 (RBR Brancker, Canada) for real time data conversion to calibrated temperatures and data storage. A Y-splice cable connection accomplished real time data transfer through the ROV's RS232 data line, galvanically separated by an opto-coupler, and the display on a ROV control van monitor. Prior to the cruise a 23-points high-precision calibration covering 0-450 °C was performed at an ISO-certified calibration lab for each of the sensors.

A newly developed deep sea peristaltic pump has now been added to the KIPS system. The pump delivers 10 ml/min dissolved reagent from a polyethylene transfusion bag into one (up to 3) sample flask. The pump is switched on and off through the ROV telemetry. The pump rate can be varied by choosing peristaltic tubing with different diameter.

Titanium syringe water samplers ("Majors")

In addition to the KIPS, two titanium syringes ("Majors" after von Damm et al., 1985; manufactured by IFREMER/ BREST-MECA) had been prepared to collect hot hydrothermal fluids at Turtle Pits, Comfortless Cove and Red Lion. The total sample volume for one major is 750 ml (Fig. 5.4-3). The samplers are made of titanium with seals made from Teflon and Viton. The syringes are not gas-tight, too: a simple lab test showed that bubbling from the samplers started at 1.5 bars overpressure. They are constructed to be self-flushing and are sent to the seafloor in chocked mode. To take a fluid sample, the snorkel is placed into the vent orifice. First, only the snorkel gets flushed by the fluid; a control for a good position within undiluted fluid is allowed by observing the small flushing vent opening above the snorkel inlet venting clear fluid without black smoke.

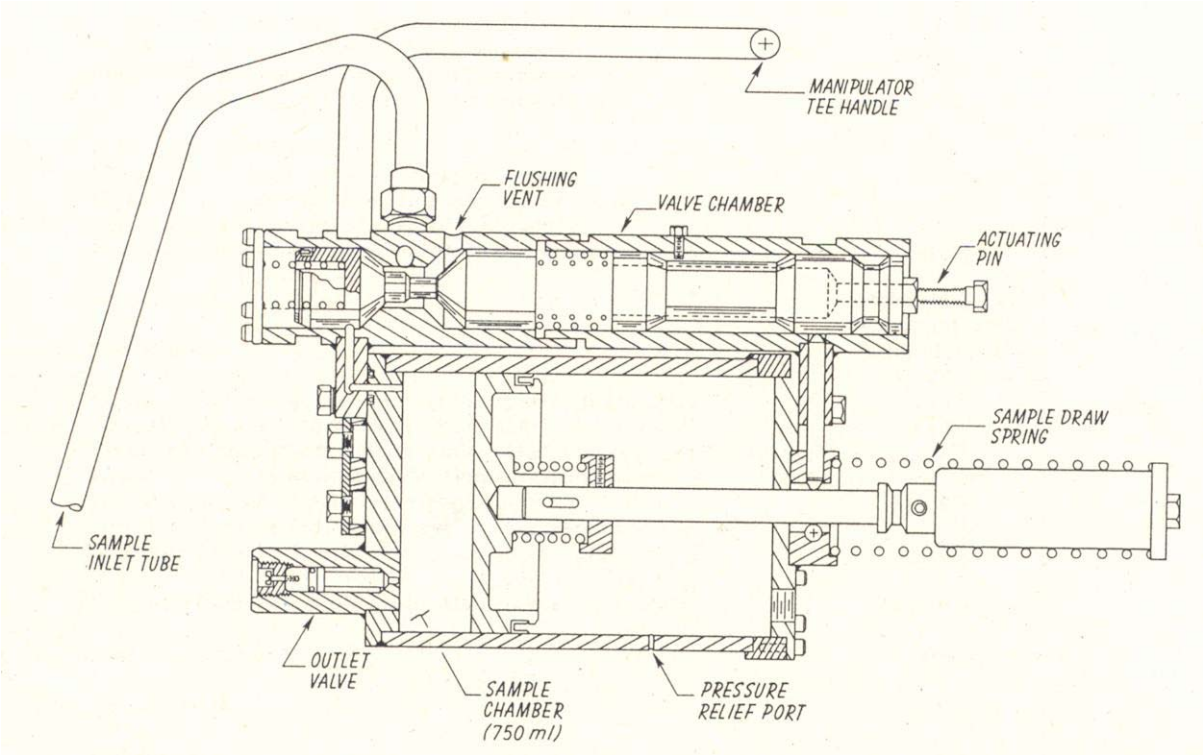

Fig. 3: Schematic drawing of the "Majors" titanium syringe sampler after von Damm, 1985 (*Geochimica et Cosmochimica Acta* **49**, 2197–2220).

Triggering the sampler is accomplished by pushing the releaser with a hydraulic piston mounted on the ROV manipulator arm. This releaser 1) closes the flushing valve, 2) opens the valve to the sample chamber, and 3) releases the pin holding the piston rod so that the large spring can pull the piston back soaking hydrothermal fluid into the sample chamber. To recover the sample on board tubing is connected to the small outlet valve of the sample chamber. For gas sampling, a vacuum extraction line can be connected. Usually, thin black coatings in the sample chamber and on sealings can be observed after sampling indicating that sulfides precipitated from the sampled fluid. These coatings are lost during sub-sampling and, hence, are not part of the analysis.

In total, 24 hot fluid samples were collected utilizing KIPS and Majors: two from Turtle Pits (One Boat), seven from Comfortless Cove (Sisters Peak), six from Red Lion (Mephisto) and nine

from Nibelungen (Drachenschlund). Diffuse fluids were collected at different locations at Comfortless Cove (four samples at Foggy Corner, thirteen samples from Clueless/Desperate and four samples from Sisters Peak) and twenty-five samples at the Main Lilliput field.

Sub-sampling and sample preparation for on-board analyses and subsequent measurements in the home laboratories

Immediately after recovery of the ROV on deck KIPS sample racks A-C were transferred to the laboratory for sub-sampling following a standardized protocol (see Tab.1, appendix). In addition to the onboard analyses, further fluid sample aliquots were taken for measuring fluid chemical composition and selected isotopes.

Each sample rack was homogenized by shaking before sub-sampling into the respective sampling vials: (i) 2 ml for major elements incl. Mg, (ii) 60 ml of original fluid for anions, (iii) 60 ml original fluid, not filtrated, acidified with 1-5 ml subboiled HNO_3 per 100 ml fluid and stored in PFA bottles, (iv) 60 ml pressure filtrated (99.9990 nitrogen) through 0.2 µm Nuclepore PC membrane filters in a Sartorius filtration unit, acidified with 0.2 ml subboiled concentrated nitric acid per 100 ml and also stored in 100 ml PFA bottles until analyses, (v) 30 ml for pH, and Mg onboard analyses. Further sub-samples are summarized in Table 1. Procedural blanks were processed in regular intervals. All work was done in a class 100 clean bench (Slee, Germany) using all-plastic labware (HDPE, PC, FEP, PFA). Rinse water was ultrapure (>18.2 MOhm) dispensed from a Millipore Milli-Q system.

After return to the home labs in Kiel and Bremen samples will be analysed for major and minor elemental composition (Na, K, Ca, Mg, Sr, Ba, B, Fe, Mn, Cu, Zn) by means of ICP-optical emission spectrometry (Ciros SOP; Spectro) and trace elements (e.g., I, Br, B, Li, Al, Ti, Cs, Ba, Sr, Y-REE, Fe, Mn, Cr, V, Cu, Co, Ni, Pb, U, Mo, As, Sb, W) by ICP-mass spectrometry using both collision-cell quadrupole (U-Kiel: 7500 cs, Agilent, JU-Bremen: Elan DRC-e, Perkin Elmer) and high resolution sector-field instrumentation (U-Kiel: PlasmaTrace 2, Micromass). At Jacobs University in Bremen (JUB), complementary analyses on the speciation of metals will be carried out using voltammetry (Computrace VA 757, Metrohm). For Cu-ligand analysis non-filtered sub-samples were immediately frozen (-20°C) as 350 ml aliquots. For anion analyses (e.g., Cl^-, Br, I^-, SO_4^{2-}), aliquots of hot hydrothermal fluids containing particles were pressure-filtrated through 0.2 µm PC membrane filters (Nuclepore). Filters were kept in plastic containers. For SO_4^{2-} analysis a 3% zinc-acetate solution was added to aliquots of hot hydrothermal fluids and resulting precipitated zinc sulfides were filtered off to prevent the addition of oxidised H_2S to the initial sulfate content. Samples for the determination of dissolved inorganic silica were diluted 1:50 from the concentrated fluid (filtered and acidified) with DI water.

Further sub-samples were collected for stable isotope analyses. Filtered aliquots of hot hydrothermal fluids (2x2 ml) were stored with no headspace in crimp-sealed glass vials for hydrogen (δ^2H) and oxygen isotope measurements ($\delta^{18}O$). Hydrogen sulfide dissolved in the hydrothermal fluids was precipitated as zinc sulfide with a 3% zinc-acetate solution, filtered and

dried for measuring the four stable sulfur isotopes (^{32}S, ^{33}S, ^{34}S, ^{36}S). For determining the carbon isotopic composition of inorganic carbon ($\delta^{13}C$) dissolved in hot and diffuse hydrothermal fluids, 20 ml aliquots were poisoned with two drops of $HgCl_2$ and stored in the dark. Stable isotope measurements will be carried out at the Geologisch-Paläontologisches Institut, Universität Münster, Germany. For Ca, Sr, and Cl isotope measurements, 50 ml of non-filtered hydrothermal fluid were stored in HDPE bottles.

Analytical procedures on-board ship

In general, on-board measurements were performed immediately after sample recovery on deck. Sampling followed a standardized protocol in order to avoid oxidation of highly redox-sensitive dissolved constituents in the hydrothermal fluids.

pH measurements. For all samples collected during ROV dives pH was measured with a WTW electrode (Ag/AgCl reference electrode) on unfiltered sample aliquots immediately after sample recovery.

Dissolved oxygen. Dissolved oxygen was determined in diffuse hydrothermal fluids only following the classical Winkler method as outlined in Grasshoff (1999). Dissolved oxygen oxidizes Mn-II in alkaline solution. In the second step of the procedure, the formed Mn-III ions stoechiometrically oxidize added KI in acidic solution to iodine that is iodometrically titrated with thiosulphate. The method was slightly modified in order to utilize 10 ml volumetric flasks. The detection limit is approx. 0.5 ml/l O_2, precision is in the range of ± 0.1 ml/l O_2. The samples were analysed by Mirjam Perner and Nico Rychlik (see section on Microbiological Diversity).

Magnesium. The content of Ca and Mg was calculated after a sample titration using Erio T as an indicator and alkaline buffer medium (pH 10 with NH_4Cl/NH_3 buffer solution). The pH was first adjusted to 10 and after addition of a small amount of Erio T, the solution was titrated from red to blue with EDTA 0.1 M solution. Ca concentrations were determined using Murexid as an indicator and alkaline medium (pH ≥12 with NaOH 1 M solution). The pH was adjusted, Murexid was added, and the solution was titrated from red to violet with EDTA 0.1 M solution. The Ca content was then subtracted from the total content of Ca and Mg to obtain the Mg concentrations.

Dissolved sulfide. For onboard analysis of dissolved sulfide concentrations Spectrophotometry was used. Spectrophotometry of dissolved sulfide is based on the light absorption of methylene blue at a wavelength of 660 nm. Dissolved sulfide is stabilized in a colloidal form as zinc sulfide using zinc acetate gelatine solution (100 µl for 1 ml of hydrothermal fluid). The sulfide reacts with N,N_dimethyl-1,4-phenylene-diamine-dihydrochloride to colourless leucomethylene and – through oxidation by Fe(III) supplied by an $FeCl_3$-solution – further to methylene blue. Photometric measurements were performed using a Biochrom Libra S12 spectrophotometer. Concentrations of the freshly prepared stock solution utilized for calibration were determined by titration with a 0,02N sodium-thiosulfate solution.

Dissolved trace metals. Concentrations of trace metals (Zn, Cu) in the diffuse fluids were analysed by voltammetry, a highly sensitive electrochemical method. Measurements were performed using a 757 VA Computrace stand (Metrohm) with a standard PC. The three-electrode

configuration included a multi-mode electrode (MME) as the working electrode, an Ag/AgCl reference electrode (3 M KCl), and a glassy carbon electrode as the auxiliary electrode. Unfiltered fluid samples 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 two hours of UV irradiation, the total content of Zn, Cu in selected samples were determined by the standard addition method. Samples were buffered at pH 4.6 with 1 M acetate buffer solution and measured by ASV (Application on Bulletin Metrohm 231/ 2).

Table 1: Summary of hydrothermal fluid sub-samples taken during cruise M 78/2

							Jacobs University Bremen, AG Koschinsky							Price, MARUM	Dittmar MPI	WestfŠl. Wilhelms-UniversitŠt MŸnster, AG Straus§				Christian-Albrechts-Univ. Kiel, AG Garbe-Schšnberg			Uni Hamburg AG Seifert		U Hambg. AG Perner
Location	Station Nr.	Sample ID	Bottle	Sample Type	Date	on-board	Sulfate	Cations NF	Cations F	Silica	REEs	AAs	Cu-ligands	As-species	DOM	S-Iso	DIC	H-Iso, O-Iso	S species	Mg-det.	Trace elems.	Majors	H2, CH4, stable Iso.	Organo-halogens	Micro-biology
Foggy Corner	267 ROV	1	A2	diffuse fluid	16.04.2009	x														x	x		x		
		2	A3	diffuse fluid		x			x											x					
		3	B4	diffuse fluid		x														x					
		4	Niskin	diffuse fluid		x			x								x						x	x	
Turtle Pits, One Boat	281 ROV	1	D1	hot fluid	18.04.2009	x		x	x	x				x		x	x	x		x	x	x		x	
		2	D2	hot fluid		x		x	x	x						x	x	x		x	x	x	x		
Foggy Corner	287 ROV	1	Niskin	diffuse fluid	19.04.2009	x					x					x	x			x			x	x	
		2	A1+ZnAc	diffuse fluid		x										x				x					
		3	A2	diffuse fluid		x														x			x		
		4	A3	diffuse fluid		x			x											x	x	x			
		5	B4	diffuse fluid		x			x											x					
Desperate		6	B5	diffuse fluid		x			x							x				x					
		7	B6	diffuse fluid		x			x											x					
		8	C7	diffuse fluid		x			x		x						x			x					
		9	C8	diffuse fluid		x														x				x	
		10	C9	diffuse fluid		x			x								x			x					
Red Lion, Mephisto	297 ROV	2	A1(ZnAc)	hot fluid	21.04.2009	x	x									x		x	x	x	x	x			
		3	A2	hot fluid		x		x							x			x	x	x					
		4	A3	hot fluid		x	x	x								x		x	x	x	x	x			
		5	B4	hot fluid		x														x					
		6	B5	hot fluid		x	x	x		x				x		x	x	x	x	x	x	x	x	x	
		7	B6	hot fluid		x	x	x								x	x	x	x	x	x	x			
Sisters	302 ROV	1	D1, Major	hot fluid	22.04.2009	x	x	x								x	x			x	x			x	
		5	C8	diffuse fluid		x			x											x	x	x	x	x	
Sisters Peak, diffus		6	C7	diffuse fluid		x											x			x					
		7	C9	diffuse fluid		x														x					
		8	B6	diffuse fluid		x			x											x					
		9	A1	diffuse fluid		x	x									x				x					
		10	A2	diffuse fluid		x														x			x		
Clueless		11	A3	diffuse fluid		x			x											x					
		12	B4	diffuse fluid		x	x									x				x					
		13	B5	diffuse fluid		x			x								x			x	x	x			
Sisters Peak	308 ROV	2	A2	hot fluid	23.04.2009	x														x			x		
		3	A1	hot fluid		x	x									x		x		x					
		4	A3	hot fluid		x	x	x		x					x	x	x	x		x	x	x		x	
		5	B4	hot fluid		x	x	x	x	x						x	x	x		x	x	x			
		6	B5	hot fluid		x	x	x	x	x					+	x		x		x	x	x			
		7	B6	hot fluid		x	x	x	x	x				x	x	x	x	x		x	x	x			
		8	D2 Major	hot fluid		x	x	x	x							x	x	x		x	x	x	x		
Nibelungen Drachensch lund	314 ROV	1	A1+ZnAc	hot fluid	27.04.2009	x										x		x	x	x					
		2	A2	hot fluid		x		x		x								x	x	x	x	x		x	
		3	A3	hot fluid		x		x	x	x						x		x	x	x	x	x			
		4	B4	hot fluid		x		x	x					x		x	x	x	x	x	x	x			
		5	B5	hot fluid		x		x	x	x								x	x	x	x	x		x	
		6	B6	hot fluid		x		x		x								x	x	x	x	x	x		
		7	C7	hot fluid		x		x	x								x	x		x					
		8	C8	hot fluid		x												x		x	x	x	x		
		9	C9	hot fluid		x												x		x					
Lilliput main	319 ROV	2	C7	diffuse fluid	29.04.2009	x														x			x		
		3	C8	diffuse fluid		x														x	x	x			
		4	C9	diffuse fluid		x			x											x					
		6	A2	diffuse fluid		x			x											x				x	
		7	A3	diffuse fluid		x			x			x	x							x	x	x	x		
		11	B4	diffuse fluid		x														x			x		
		12	B5	diffuse fluid		x			x											x	x	x			
		13	B6	diffuse fluid		x			x											x					
		14	A1+ZnAc	diffuse fluid		x										x				x					
Lilliput main	324 ROV	1	A2	diffuse fluid	30.04.2009	x														x			x		
		2	A3	diffuse fluid		x			x											x					
		3	B4	diffuse fluid		x														x					
		4	B5	diffuse fluid		x			x		x (Nd isotopes)									x					
		5	B6	diffuse fluid		x											x			x					
		6	C7	diffuse fluid		x														x					
		7	C8	diffuse fluid		x														x	x	x			
		8	C9	diffuse fluid		x														x					
		9	A1+ZnAc	diffuse fluid		x										x				x					
Lilliput main	329 ROV	1	C7	diffuse fluid	01.05.2009	x														x					
		2	C8	diffuse fluid		x														x			x		
		3	C9	diffuse fluid		x														x	x				
Lilliput main	335 ROV	1	A2	diffuse fluid	02.05.2009	x														x			x		
		2	A3	diffuse fluid		x														x	x	x			
		3	B4	diffuse fluid		x														x		x			
		4	A1	diffuse fluid		x										x				x					

Abbreviations: onboard: determination of pH, Eh, Mg, H_2S; F: filtered; NF: non-filtered; Si-det: silica determination; Ti-det.: titanium determination; AAs: Amino Acids; DOM: dissolved organic matter; DIC: Dissolved Inorganic Carbon; S-Iso: Sulfur isotopes; H-Iso: Hydrogen Isotopes; O-Iso: Oxygen Isotopes; Mg-det: magnesium determination

Appendix 2.5 Gas Data

ROV/CTD	Niskin	Tiefe (m)	nM H_2	nM CH_4	H2/CH4	nM CO	nM CO2
			# = below detection limit				
ROV267							
	KIPS A2		0.9	16.8	0.052	379.8	51165.5
	Niskin		0.4	6.0	0.068	241.1	44195.6
CTD270							
	1	3080	1.4	1.0	1.365		
	2	3020	5.8	2.2	2.615		
	3	2970	7.9	2.3	3.466		
	4	2920	1.5	1.3	1.145		
	5	2880	11.3	2.6	4.322		
	6	2840	14.2	3.0	4.686		
	7	2820					
	8	2800	0.7	1.3	0.517		
	9	2750	0.4	#			
ROV281							
One Boat	Major D2		544518.4	18863.3	28.867	21491.6	16401249.2
One Boat	Major D2		517058.8	19750.9	26.179	16672.9	13566763.0
One Boat	Major D2		564643.6	20937.1	26.969	14233.1	11454308.4
CTD283							
	1	2930	1279.1	51.4	24.879		
	2	2920	82.2	4.6	17.974		
	4	2890	33.1	2.6	12.705		
	6	2865	21.4	1.8	12.216		
	7	2840	17.9	2.2	8.259		
	10	2815	15.0	2.1	7.327		
	11	2790	8.6	1.3	6.761		
	13	2750	9.6	1.4	6.707		
	15	2700	7.7	#			
ROV287							
	KIPS A2		5.8	27.8	0.209	274.5	81143.6
	KIPS A2		6.5	23.4	0.279	190.5	66330.45
	Niskin Foggy Corner	3.5	7.0	0.495		348.3	51089.1
CTD294	2	3100	0.3	#			
	5	3000	3.0	0.8	3.718		
	9	2900	3.0	1.1	2.673		
CTD294							
	13	2800	3.4	1.2	2.878		
	15	2750	2.6	0.6	4.177		
	17	2700	2.5	0.8	3.083		
	19	2600	2.2	0.7	3.236		
	21	2400	#	#			
CTD295							
	2	2920	2.4	#			
	4	2870	1.5	0.9	1.669		
	5	2840	1.6	1.1	1.417		
	6	2800	1.7	0.9	1.888		
	7	2750	1.4	1.0	1.429		
	9	2700	0.7	0.9	0.775		
	10	2600	1.1	#			

ROV/CTD	Niskin	Tiefe (m)	nM H_2	nM CH_4	H2/CH4	nM CO	nM CO2
ROV297							
Mephisto	KIPS B5		317336.8	50503.4	6.283	71867.6	5302536.8
Mephisto	KIPS B5		314185.1	49557.2	6.340	59267.6	4847911.7
Mephisto	KIPS B5		350808.1	55070.8	6.370	65718.0	19119912.4
ROV302							
Sisters Peak diffus	KIPS C8		1149.5	560.6	2.050	1089.5	429427.3
Sisters Peak diffus	KIPS C8		1185.2	606.7	1.953		245094.1
Clueless	KIPS A2		226.6	2071.5	0.109	2178.3	218145.0
ROV308							
Sisters Peak	Major D2		3558.2	3477.1	1.023		11664841.6
Sisters Peak	Major D2		3802.1	4063.6	0.936		6448566.0
Sisters Peak	KIPS A2		45780.2	10551.4	4.339		8556632.9
Sisters Peak	KIPS A2		51835.6	11375.9	4.557		
ROV314							
Drachenschlund	KIPS B6		2067.2	4147.3	0.498	362046.0	1549255.1
Drachenschlund	KIPS B6		1671.8	2592.2	0.645	300303.8	1362094.5
Drachenschlund	KIPS C8		26852.4	4480.8	5.993	623432.8	930019.8
Drachenschlund	KIPS C8		17091.2	3248.7	5.261	539125.9	817447.9
ROV319 Lilliput							
	KIPS C7*		3594.2	3871.3	0.928	3977.5	300633.8
	KIPS A3		2398.3	5203.3	0.461	5845.6	229447.3
	KIPS B4		1881.2	4809.8	0.391	5357.2	278173.6
	*Mindestwert da Probe mit Luft verdünnt						
CTD321							
	1	1490	206.9	51.0	4.055		
	3	1460	60.4	18.2	3.326		
	5	1430	38.3	16.8	2.285		
	7	1400	33.3	10.7	3.118		
	9	1350	23.7	7.9	2.980		
	11	1300	22.1	7.3	3.043		
	13	1200	16.8	5.7	2.926		
	15	1000	19.2	6.0	3.169		
ROV324							
Lilliput Tiden	KIPS A2		870.2	5992.2	0.145	4692.2	384726.7
Lilliput Tiden	KIPS A2		906.4	6245.7	0.145		
CTD327							
	1	1640	14.0	20.9	0.670		
	3	1600	12.1	8.2	1.470		
	5	1570	11.9	8.9	1.339		
	7	1540	9.3	8.4	1.107		
	9	1500	12.1	9.9	1.213		
	11	1470	11.8	7.9	1.498		
	13	1440	7.7	6.2	1.241		
	15	1400	6.6	5.9	1.122		
ROV329							
Lilliput Tiden	KIPS C8		163.2	1837.7	0.089		
ROV335							
Lilliput Tiden	KIPS A2		179.0	6643.8	0.027		
Lilliput Tiden	KIPS A2		135.3	6488.2	0.021		
			157.2	6566.0	0.024		

Appendix 2.6: Microbiology samples list of ROV dives

Sample number	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
267 ROV 2 + 3	Foggy corner	KIPS A2 + B4	240±17	200 ml	650 ml	--	Thermales RT
							Thermales 37°C
							Thermales 55°C
							Desulfurobacterium; 4°C
							Desulfurobacterium; 55°C
							Desulfurobacterium; 75°C
							Methanococcales; 37°C
							Methanococcales; 75°C
							Thermococcales; 37°C
							Thermococcales; 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 4°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 4°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C
267 ROV 4	Foggy Corner	Niskin	209±24	200 ml	500 ml	500 ml 700 ml	MAR-FISH / Incubation with 14C
274 ROV 1-A	Sisters Peak	chimney piece			500g		
274 ROV 1-B		chimney piece			1kg		
281 ROV 5	One Boat	Major D2	--	--	--	--	Desulfurobacterium; 55°C
							Desulfurobacterium; 75°C
							Methanococcales; 55°C
							Methanococcales; 75°C

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
287 ROV 1	Foggy Corner	Niskin	264±9	300 ml	1700 ml	--	--
287 ROV 4	New Site "Desperate"	KIPS A3	226	--	--	--	--
287 ROV 5		KIPS B4	185	--	--	--	--
287 ROV 6		KIPS B5	170	--	--	--	--
287 ROV 7		KIPS B6	168	--	--	--	--
287 ROV 8		KIPS C7	246	--	--	--	--
287 ROV 9		KIPS C8	143	--	--	--	--
287 ROV 10		KIPS C9	203	--	--	--	--
287 ROV 4-7	New Site "Desperate"			200 ml	400 ml	--	Thermales RT
							Thermales 37°C
							Desulfurobacterium; RT
							Desulfurobacterium; 37°C
							Methanococcales; RT
							Methanococcales; 37°C
							Thermococcales; RT
							Thermococcales; 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 37°C
							MAR-FISH / Incubation with 14C
287 ROV 8-10	New Site "Desperate"			100 ml	250 ml	2x 250 ml	--

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
297 ROV 5	Mephisto	KIPS B4	--	--	--	--	Desulfurobacterium; 37°C
							Desulfurobacterium; 55°C
							Desulfurobacterium; 75°C
							Methanococcales; 37°C
							Methanococcales; 55°C
							Methanococcales; 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 75°C
297 ROV 1	Mephisto	rock sample			size?		
302 ROV 6	Sisters Peak	KIPS C7	141±21	--	--	--	--
302 ROV 7		KIPS C9	162±0	--	--	--	--
302 ROV 8		KIPS B6	122±7	--	--	--	--
302 ROV 6 – 8	Sisters Peak	KIPS C7, C9 + B6		250 ml	2x 250 ml	500 ml	Desulfurobacterium; RT
							Desulfurobacterium; 55°C
							Methanococcales; 37°C
							Methanococcales; 75°C
							Thermococcales; 37°C
							Thermococcales; 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C
							Culture with carbonate and H2, oxic; RT

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
302 ROV 6 – 8	Sisters Peak			250 ml	2x 250 ml	500 ml	Culture with carbonate and H2, oxic; RT
							MAR-FISH / Incubation with 14C
302 ROV 11	Clueless	KIPS A3	0	--	--	--	--
302 ROV 12		KIPS B4	0	--	--	--	--
302 ROV 13		KIPS B5	0	--	--	--	--
302 ROV 10 – 13	Clueless	KIPS A3, B4 + B5		250 ml	350 ml	450 ml	Desulfurobacterium; RT
							Desulfurobacterium; 55°C
							Methanococcales; 37°C
							Methanococcales; 75°C
							Thermococcales; 37°C
							Thermococcales; 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C
							Culture with carbonate and H2, oxic; RT
							Culture with carbonate and H2, oxic; RT
308 ROV 1		Sample Fe-oxide mound with old chimneys		--	--	--	
312 ROV 1	Nibelungen	inactive chimney piece	--	50 g	1 kg	--	
314 ROV 7	Dragon Throat	KIPS C7	25±20				
314 ROV 9	Dragon Throat	KIPS C9	87±18		400 ml		
314 ROV 7-9	Dragon Throat	KIPS C7 + C8 + C9					Desulfurobacterium; 55°C
							Desulfurobacterium; 75°C

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
314 ROV 7-9		KIPS C7 + C8 + C9					Methanococcales; 55°C
							Methanococcales; 75°C
							Thermococcales; 55°C
							Thermococcales; 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 75°C
							Arcchaeoglobus; 55°C
							Arcchaeoglobus; 75°C
							MAR-FISH / Incubation with 14C
319 ROV 3	Lilliput	C8	90±23	--	--	--	--
319 ROV 4		C9	210±9	--	--	--	--
319 ROV 12		B5	80±5	--	--	--	--
319 ROV 13		B6	109±5	--	--	--	--
319 ROV 2 - 4	Lilliput	C7 - C9	--	150 ml	400 ml	450 ml	
319 ROV 11 - 13		B4 - B6	--	150 ml	350 ml	450 ml	
319 ROV 2-4+11-13	Lilliput	B4 - B6 + C7 - C9					Thermales; RT
							Thermales; 37°C
							Desulfurobacterium; RT°C
							Desulfurobacterium; 37°C
							Methanococcales; 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
319 ROV 2-4+11-13	Lilliput	B4 - B6 + C7 - C9					Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C
319 ROV 15	Lilliput	mat slurp		2 ml Eppi	filters and raw material	2 ml Eppi	
324 ROV 2	Lilliput	KIPS A3	93±10	--	--	--	--
324 ROV 3		KIPS B4	91±13	--	--	--	--
324 ROV 4		KIPS B5		--	--	--	--
324 ROV 5		KIPS B6	71±3	--	--	--	--
324 ROV 7		KIPS C8	69±9	--	--	--	--
324 ROV 8		KIPS C9	72±12	--	--	--	--
324 ROV 2 - 4	Lilliput	KIPS A3, B4 + B5 KIPS B6, C7, C8 + C9	--	150 ml	350 ml	450 ml	Thermales; RT
324 ROV 5-8				+ 50 ml	+ 200 ml		Thermales; 37°C
							Desulfurobacterium; RT°C
							Desulfurobacterium; 37°C
							Methanococcales; 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); RT
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 55°C

ROV	sampling site	NISKIN/ KIPS	Winkler: O_2 [µM]	FISH (4°C)	DNA (-80°C)	RNA (-80°C)	Cultures & incubations
324 ROV 5 - 8	Lilliput	KIPS B6, C7, C8, C9					MAR-FISH / Incubation with 14C
329 ROV 1	Lilliput	KIPS C7	89±3	--	--	--	--
329 ROV 1 + 3	Lilliput	KIPS C7 + C9	--				Thermales; 55°C
							Thermales; 75°C
							Desulfurobacterium; 55°C
							Desulfurobacterium; 75°C
							Methanococcales; 55°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 4°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2); 75°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 4°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 37°C
							Aquifex & Epsilonproteobacteria (H2/CO2/O2); 75°C
335 ROV 3	Lilliput	KIPS A3	92±4	--	--	--	--
335 ROV 3 - 4	Lilliput	KIPS A3 + B4	--	200 ml	400 ml	400 ml	--

Appendix 2.7 Animals collected during M 78/2 for symbioses research.

Sample number	Site	Sample type	Purpose
267 ROV 4	Foggy Corner	Scoop net	*Bathymodiolus* sp. samples for DNA and FISCH, elctron microspopy and stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells)
274 ROV 3	Golden Valley	Scoop net	*Bathymodiolus* sp. samples for DNA and FISCH, elctron microspopy, stable isotopes ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) and trace metal analyses. Juvenile *Bathymodiolus* sp. specimens for whole-body FISH analyses
274 ROV 4	Golden Valley	Rock sample	*Juvenile Bathymodiolus* sp. specimens for whole-body FISH analyses
287 ROV 11	Desperate	DieFast 1	*Whole Bathymodiolus sp. specimens fixed in situ for FISH*
287 ROV 12	Desperate	Scoop shouvel	*Bathymodiolus* sp. samples for DNA, FISCH, elctron microspopy, stable isotopes ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells), and homogenisations of gill tissue for FACS
302 ROV 3 and 4	Sister's Peak	Slurp	*Rimicaris exoculata* samples for DNA , RNA and FISH analyses and for incubation experiments with $^{13}CO_2$
302 ROV 14	Clueless	DieFast 2	*Whole Bathymodiolus sp. specimens fixed in situ for RNA analyses*
302 ROV 15	Clueless	Scoop shouvel	*Bathymodiolus* sp. samples for DNA and FISCH, elctron microspopy and stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells)
302 ROV 16	Clueless	DieFast 1	*Whole Bathymodiolus sp. specimens fixed in situ for FISH*
308 ROV 9	Golden Valley	Rock sample	*Juvenile Bathymodiolus* sp. specimens for whole-body FISH analyses
308 ROV 10	Golden Valley	Scoop net	*Bathymodiolus* sp. samples for DNA, FISCH, elctron microspopy, stable isotopes ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells), density centrifugation and homogenisations of gill tissue
319 ROV 5	Lilliput	Scoop net	*Bathymodiolus* sp. samples for DNA and FISCH, elctron microspopy and stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells)
319 ROV 8	Lilliput	DieFast 2	*Whole Bathymodiolus* sp. specimens fixed in situ for RNA analyses
319 ROV 9	Lilliput	DieFast 1	*Whole Bathymodiolus* sp. specimens fixed in situ for FISH
324 ROV 10	Lilliput	Scoop net	*Bathymodiolus* sp. samples for DNA, FISCH, elctron microspopy, stable isotopes ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells) trace metals and homogenisations of gill tissue

Sample number	Site	Sample type	Purpose
329 ROV 4	Lilliput	Scoop net	*Bathymodiolus* sp. samples for DNA and FISH analyses
335 ROV 5	Lilliput	Scoop net	*Bathymodiolus* sp. samples for DNA, FISCH, elctron microspopy, stable isotopes ($\delta^{13}C$, $\delta^{15}N$ of tissues and $\delta^{18}O$ of shells) trace metals and homogenisations of gill tissue. Juvenile Bathymodiolus sp. specimens for whole-body FISH analyses

Appendix 2.8 Temperature Measurements of Hydrothermal Fluids (to 2.4.10)

Methods. A high-precision temperature probe with stainless steel pressure housing (manufactured by H.-H. Gennerich, Bremen) was attached parallel to the KIPS titanium nozzle (c.f., Fig. 2.4.8-2b, Appendix). The probe is equipped with both a Pt-1000 and a NTC thermistor sensor mounted adjacent to each other. The two temperature sensors are characterized by opposite resistance-temperature relationships, with the Pt-1000 having increasing resistance with increasing temperature. Time constants (T_{90}) of both sensors in water are better than 10 s. The probe is connected to a RBR logger TBR-2050 (RBR Brancker, Canada) for real time data conversion into calibrated temperatures and data storage. A Y-splice cable connection accomplished real time data transfer through the ROV's RS232 data line and the display of in-situ temperature on a monitor in the ROV control van. The RS232 line was galvanically separated by means of an opto-coupling device. Prior to the cruise a 23-points high-precision calibration covering 0-450 °C was performed at an ISO-certified calibration lab for each of the sensors. However, we observed a systematic offset of the Pt-1000 sensor measuring low oceanic temperatures @ 2-3 °C approx. 0.2 °C lower, and high temperatures @ >350 °C approx. 4-6 °C lower than the NTC sensor. This offset must be ascribed to uncertainties in the sensors' calibration.
During stations 312/ 314 ROV at the Drachenschlund vent site a specially designed handle extension with 2 m length was used. The KIPS nozzle and temperature probe were mounted to this extension (Fig. 1) and operated with the ROV's RigMaster manipulator. Temperature probe No. 2-1 with appropriate calibration factors was used at this site while probe No. 2-2 was used at all other sites.

Fig. 1 T-handle extension (2 meters) with mounted KIPS Nozzle and temperature probe as used for the first sampling of the Drachenschlund vent.

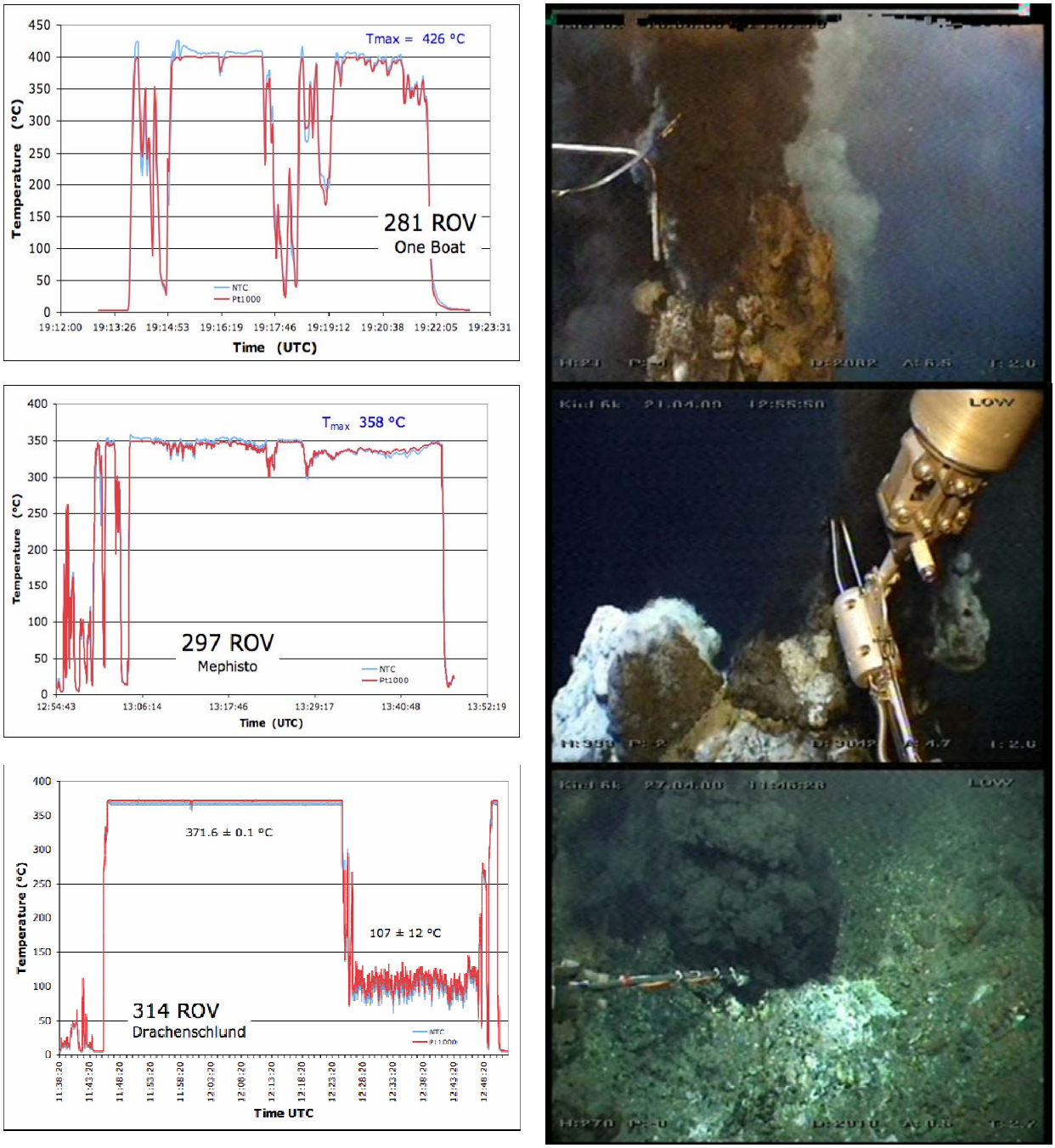

Fig. 2: Temperature logs during KIPS sampling of black smoker hydrothermal fluids at Turtle Pits (One Boat, 281 ROV), Red Lion (Mephisto, 297 ROV), and Nibelungen (Drachenschlund, 314 ROV).

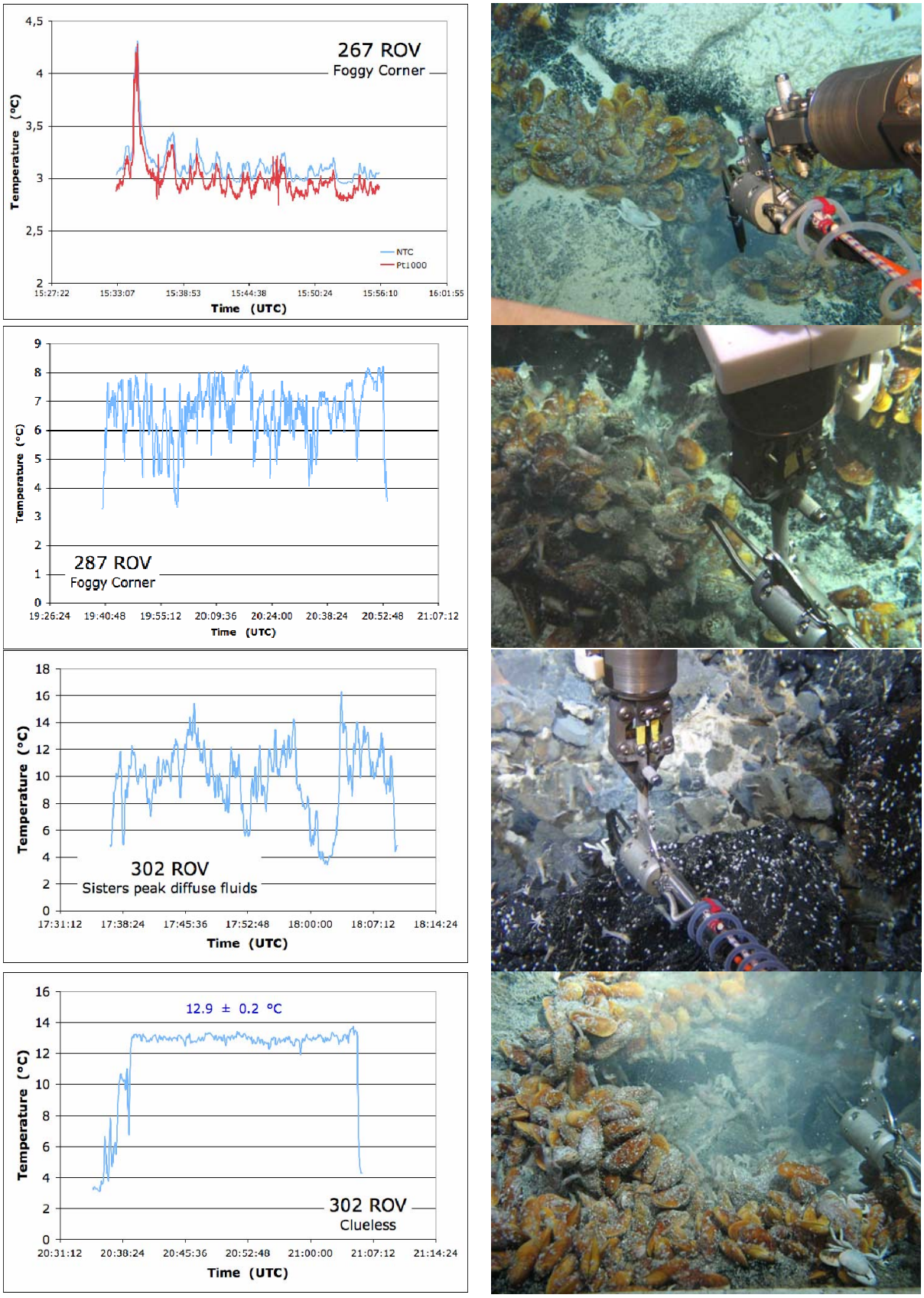

Fig. 3: Temperature logs during KIPS sampling of diffuse hydrothermal fluids in musselfields at 5 °S MAR, Comfortless Cove: Foggy Corner (267 ROV, 287 ROV), Sisters Peak and Clueless (302 ROV).

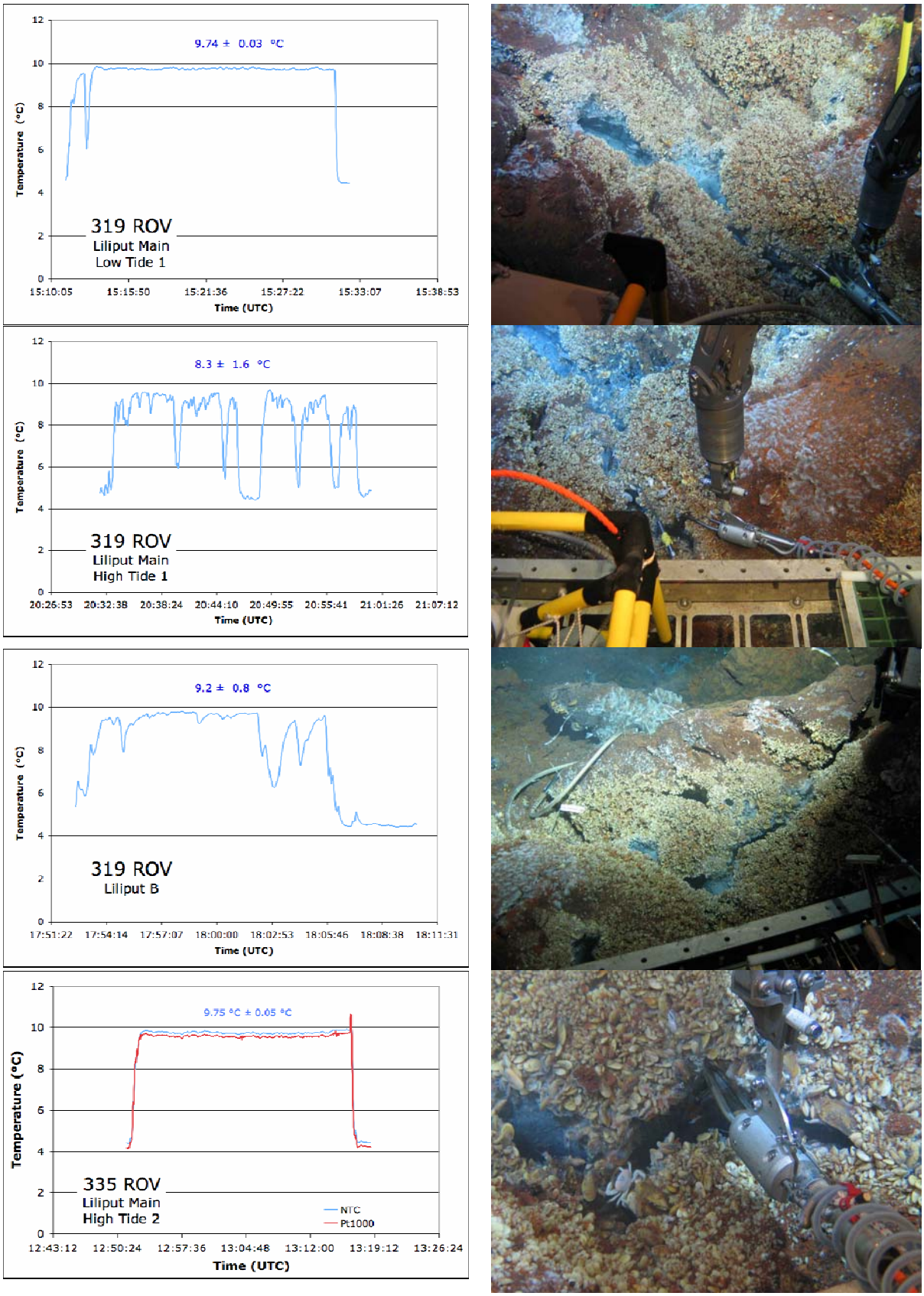

Fig. 4: Temperature logs during KIPS sampling of diffuse hydrothermal fluids in musselfields at 9°55 S MAR, Liliput Main (319 ROV and 335 ROV).