NeMO 2006 Cruise Report

Axial Volcano and the Endeavour Segment
Juan de Fuca Ridge

R/V Thomas G. THOMPSON Cruise TN-199

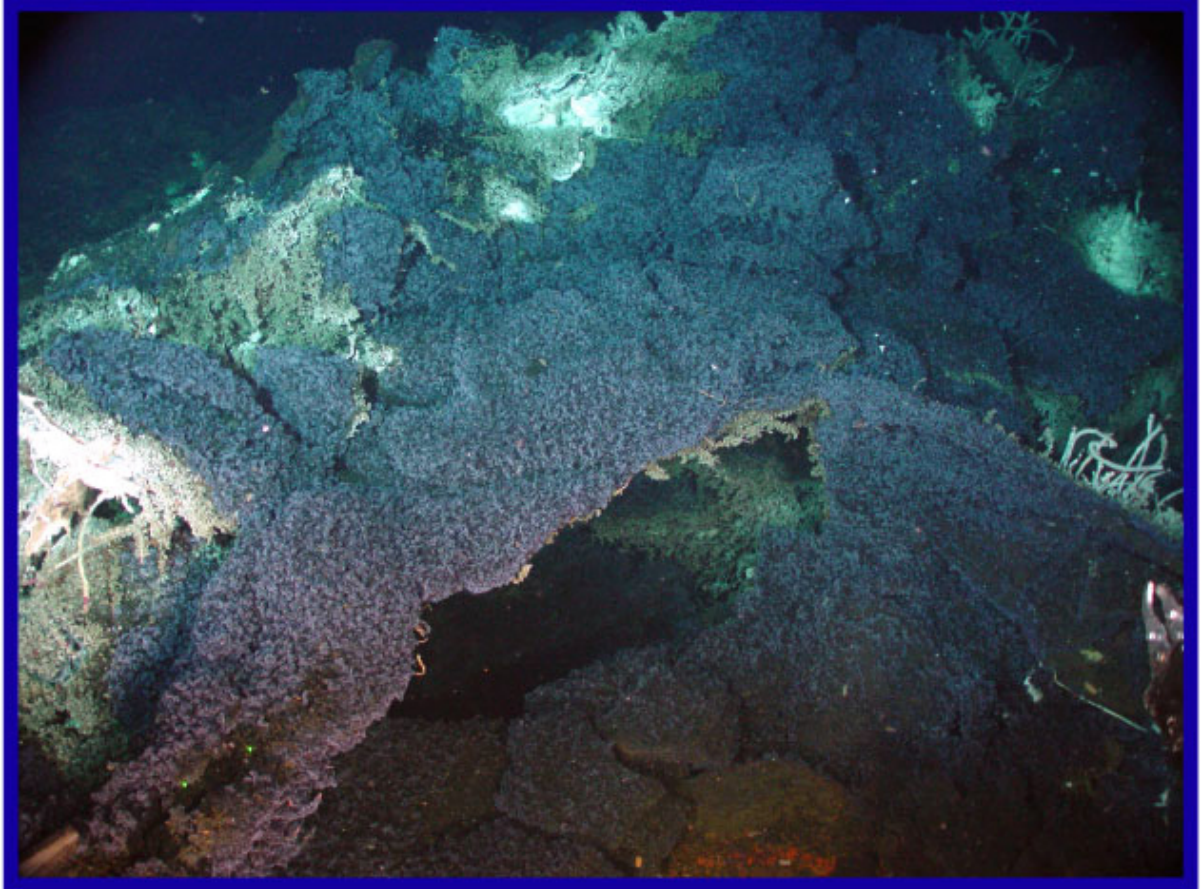
August 22 - September 7, 2006. Seattle WA to Seattle WA

ROPOS Dives R1008 - R1014

Chief Scientist: David A. Butterfield

***R/V Thompson* Captain: Al McClenaghan**

***ROPOS* Expedition Leader: Keith Tamburri**



Brief 2005 Cruise Report Appended

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NeMO 2006
NOAA Vents Program
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Cruise Report compiled by Susan Merle

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FIGURE CAPTIONS

Cover. One of the most beautiful vent sites on the 1998 lava flow is at marker N3. The large diffuse vent area is covered with a blue mat made of small single-celled organisms called ciliates. We have never seen such an extensive carpet of this unusual blue mat anywhere else in the world!

Figure 1. NeMO'06 Shipboard operations including instrument deployments and CTD casts at Axial. Ocean Bottom Hydrophone (OBH) and QUEphone deployments in 2006, as well as Bottom Pressure Recorders (BPRs) already on the seafloor are indicated. OBH moorings deployed in 2006 are represented by the blue stars and QUEphone deployment and re-surface positions are indicated by the **X** marks.

Plate 1 ROPOS Operations at Endeavour (Mothra and MEF), 2006
a) [R1008 at 0209:29] RAS (Remote Access Sampler) before recovery from the base of "The Tower" chimney on the east side of "Faulty Towers" complex. The RAS was deployed for one year, sampling water every 6 days from 9/20/2005 to 7/24/2006.
b) [R1008 at 0456:10] Fluid sampling at the 2005 Hot Harold RAS intake site, Mothra Vent Field. Very diffuse flow supports a variety of biota including a vent fish, pale tubeworms, pycnogonids, and various bivalves.
c) [R1008 at 0545:48] The top of Hot Harold (Mothra Vent Field) just prior to fluid sampling.
d) [R1009 at 2102:30] The 2005 RAS intake site at Hot Harold, Main Endeavour Field (MEF).
e) [R1009 at 2117:16] This RAS, deployed in 2005 at SW Hulk MEF, was covered in white, filamentous bacterial mat prior to recovery. The RAS was deployed for one year, sampling water every 6 days from 9/20/2005 to 7/24/2006.
f) [R1009 at 0244:19] 2006 RAS after deployment at SW Hulk, MEF.
g) [R1009 at 0536:37] Crab beneath a flange on S&M sulfide chimney, MEF.
h) [R1009 at 0806:06] University of Victoria sediment trap on the bottom before attempted recovery. The trap was deployed for 3 years at the MEF. During the ROPOS ascent the trap fell out of the claw and was lost.

Plate 2 ROPOS Operations at Axial, NeMO'06
a) [R1010 at 1759:03] The NeMO Net buoy mooring line on the bottom at the caldera center. The release was on its side and recovered at the end of dive R1013. The buoy was not found.
b) [R1010 at 2258:39] Pressure measurement at Magnesia benchmark 1. The pressure dive was a new record for ROPOS wet time (> 53 hours), although just a little over 25 hours was spent on the bottom and the rest in transit between pressure measurements.
c) [R1014 at 2047:09] The diffuse vent site at marker 113 is located within and on top of the edge of an extensive collapse area. The brightest white areas are covered with microbial mat. The surrounding areas are colonized by tubeworms, limpets, snails, and other vent biota.
d) [R1011 at 2347:56] A long-term vent fluid sampler was deployed at marker 33 vent site on dive R1011. The RAS contains 48 individual sample bottles and the white dome on the seafloor houses the fluid intake nozzle and temperature probe.
e) [R1012 at 2025:10] A view of an unusual, twisted lava pillar from the 1998 lava flow with drip formations off the pillar rind.
f) [R1011 at 2027:38] The "missing" rumbleometer at Axial, located during the NeMO'04 cruise and recovered during the NeMO'06 cruise on dive R1012.
g) [R1013 at 1829:47] Mushroom sulfide chimney at ASHES vent field is covered in dense biota including tube worms, blue mat and palm worms. The chimney was sampled for vent fluids, gas and blue mat during dive R1013.

h) [R1013 at 1921:16] The top of Inferno black smoker sulfide chimney at ASHES. The chimney is covered in lush biota. It was sampled for vent fluids and gas during dive R1013.

Plate 3: The International District at Axial, NeMO'06

a) [R1014 at 2241:36] The top of Castle sulfide chimney on older lava just east of the '98 lava flow. Castle is a large, active sulfide chimney that has been a time-series study site at Axial for many years. Castle stands over 8 meters tall with the base at ~1521.5m and the top at ~1513m

b) [R1014-at 2253] The base of Flat Top sulfide chimney, just east of Castle. Flattop is an active sulfide that stands ~7 meters high with the base at ~1518m and the top at 1511m. Flat Top has also been part of the time-series sampling at Axial.

c) [R1014 at 2300.46] 9 meter chimney newly discovered during the NeMO'06 cruise, with the assistance of the MBARI AUV high-resolution bathymetry. The chimney is active and covered in dense biota, standing 9 meters high (as the name indicates). The top of the chimney is at ~1517 meters.

d) [R1014 at 0019.05] Diva anhydrite chimney was discovered on a "wishbone-like" ridge slightly east of the sulfides. A healthy biological community lives near the base of the anhydrite and includes tube worms and blue mat.

e) [R1014 at 0127:10] Escargot sulfide chimney was also discovered on the "wishbone" to the west of Diva. The chimney was visible on the MBARI AUV bathymetry. The chimney, named "Escargot" because the top looks like a snail, is active and covered in dense biota including tubeworms and blue mat. It stands ~9 meters tall with the top at 1516.5 meters.

f) [R1014 at 0132.49] Hermosa sulfide chimney was discovered to the east of the 9 meter chimney. The ch8imney was named "Hermosa" because from some angles the top looks like a beautiful woman's profile. There was no good fix on the height of the chimney, but it is large like the other sulfides discovered on dive R1014 with the assistance of the MBARI AUV bathymetry.

f) [R1014 at 2307.43] El Guapo is the largest sulfide chimney yet discovered at Axial, approximately 13 meters tall whose top is at ~1503 m. El Guapo is a black smoker with numerous beehives coming out the top and dense biota covering large portions of the chimney.

g) [R1014 at 2331.42] The top of El Guapo chimney during HFS sampling. Notice the beehives with black smoke pouring out. ROPOS is holding on to the chimney to steadying itself during sampling. HFS recorded temperatures of 338.7 °C while sampling.

Plate 4: Newly Discovered Diffuse Venting at Axial, NeMO'06

a) [R1011 at 1640:54] Forum vent SE of Magnesia, an area of diffuse venting in a lava pillar setting. Pillars in the background are coated with limpets and possibly snails. Tubeworms thrive in the diffuse flow. Image is several meters across.

b) [R1011 at 1649:36] Close-up view of Forum vent fauna including: tube worms, palm worms, scale worms, pycnogonids, limpets, blue mat, and snails. Tmax was > 92°C while water sampling. Image ~1 m across.

c) [R1011 at 1745:49] "Little diffuse vents" discovered on dive R1011, SE of Magnesia and Forum while traveling to Mkr-N3. Healthy tubeworm bush in the diffuse flow. Image ~ 1m across.

d) [R1012 at 2243:47] Zen Garden, a fairly large area of diffuse venting on the younger lobate flow and pillars on the eastern edge of the '98 flow, north of Nascent and Old Flow. Healthy tubeworms coated in bacterial mat dangle from the top of a pillar. Image ~2 m across.

e) [R1012 at 2031:08] Chemo clams, an area where chemosynthetic clams are aligned in cracks in the sheet flow west of Mkr-33 Vent. Image > 3m across.

f) ([R1012 at 2032:11] Chemo clams close-up of live clams and stunted tubeworms lie in the iron oxide sediments along cracks in the sheet flow.

g) [R1012 at 2141:13] Pillar east of Mkr-33. Several pillars north and east of Mkr-33 were discovered with diffuse venting. Vent fauna observed included tubeworms and blue mat.

h) [R1014 at 2041:12] "New" venting area discovered on dive R1014, ~140 m south of Mkr-113. Large area of diffuse, high-volume, venting with healthy fauna including tube worms, clams, limpets, and mat. Image ~2 m across in foreground.

Figure 2. a) Spectrogram of QUEphone acoustic data. At approximately 3.5ks, low frequency T-phase energy (yellow vertical line) was detected. b) QUEphone at the surface waiting for recovery. *R/V Thompson* is in background about 1.5 km away.

Figure 3. MBARI AUV surveys at Axial during the NeMO'06 cruise produced the highest resolution bathymetry maps yet created at Axial. Six surveys were conducted, but the first survey (not shown on map) collected very little data as that was when the AUV veered off course. The bathymetry data assisted in locating lava collapse and pillar areas on traverses across the '98 flow, as well as assisting in the discovery of sulfide chimneys on ROPOS dive R1014.

Figure 4. Northern area of the MBARI AUV surveys at Axial during the NeMO'06 cruise. Data are shaded with a slope-gradient file(the darker the shading the higher the slope value). Data resolution is 0.5 meters. Slope gradient tiff files created by Jenny Paduan, MBARI.

Figure 5. Southern area of the MBARI AUV surveys at Axial during NeMO'06 cruise. Data are shaded with a slope-gradient file (the darker the shading the higher the slope value). Data resolution is 0.5 meters. Slope gradient tiff files created by Jenny Paduan, MBARI.

Figure 6. MBARI AUV bathymetry data featuring an area of pillars, collapsed and uncollapsed lava flow surfaces on the '98 lava flow. Map created by Jenny Paduan, MBARI.

Figure 7. MBARI AUV bathymetry data featuring an area of sulfide chimneys on the eastern edge of the '98 flow. Several chimneys were discovered with the aid of the high resolution bathymetry. The area of large sulfides (in the vicinity of Castle) has been dubbed the International District. Map created by Jenny Paduan, MBARI.

Figure 8. MBARI AUV bathymetry featuring an area of lava drainage channels and fissures. Map created by Jenny Paduan, MBARI.

Figure 9. EM300 bathymetry database at Axial Volcano, Juan de Fuca Ridge. The thick black line indicates the data added on the NeMO'06 cruise. All the data featured on the map were collected on NeMO expeditions, with the exception of the MBARI 1998 data in the area of the south rift zone (red line). EM300 bathymetry grid-cell size is 30 meters. Mercator projection.

Figure 10. EM300 bathymetry database at the Endeavour segment of the Juan de Fuca Ridge. NeMO'06 EM#00 bathymetry coverage are is outlined by the bold gray line. All other EM300 data presented on the map are provided courtesy of Deb Kelley, University of Washington. EM300 bathymetry grid-cell size is 30 meters. Mercator projection.

Figure 11. Dive map for R1008 (Mothra) and R1009 (Main Endeavour Field) at the Endeavour segment. Endeavour vent positions were obtained from the Ridge 2000 data portal courtesy of Deb Kelley and Deb Glickson, UW. EM300 bathymetry grid-cell size is 35 meters. 20 meter contour interval. Mercator projection.

Figure 12. Dive map for R1010, the pressure dive at Axial. Benchmarks were visited (and re-visited) from the caldera center to the south pillow mound. EM300 bathymetry grid-cell size is 30 meters. 50 meter contour interval. Mercator projection.

Figure 13. Dive map for R1011 on the northern '98 lava flow from Forum to Mkr-33. MBARI AUV bathymetry grid-cell size is 1 meter. Mercator projection.

1.0 NeMO 2006 EXPEDITION SUMMARY

Axial Volcano and the Endeavour Segment, Juan de Fuca Ridge

Dave Butterfield, Chief Scientist (JISAO/ UW /PMEL)

The NeMO 2006 expedition is the eighth in the string of submersible cruises that started in 1998 when the PMEL VENTS Program began a multi-year seafloor volcano observatory. With the exception of 2005, every cruise has involved the remotely operated vehicle *ROPOS*, as well as water column hydrothermal plume measurements and a heavy emphasis on seafloor instrumentation (Figure 1). In 2006, we also added a second, highly capable mapping vehicle, the *D. Allen B.* autonomous underwater vehicle (AUV) from MBARI. The University of Victoria provided NSERC funding for four days of *ROPOS* operations and NOAA/PMEL provided the funding for the ship and the remaining *ROPOS* time.

It was an exciting and productive two weeks of oceanographic science. Time-series water and microbial DNA samplers were recovered and deployed at the Endeavour Integrated Studies Site (Plate 1) and also deployed at Axial Volcano (Plate 2) for another year of weekly monitoring to detect responses to volcanic or tectonic events. Initial results show a surprisingly large change over the past year at one site in the Mothra vent field at Endeavour. Throughout the cruise, we collected a large and varied set of water column, vent fluid, rock, sediment, vent fauna, and microbial DNA samples, including adapting a pump system to take very large volume DNA samples in a very short time. We recovered temperature recorders from warm and hot vents around the caldera, deployed more temperature recorders, recovered a Volcanic System Monitor (or "Rumble-ometer") using the *ROPOS* heavy lift capability, deployed 4 ocean bottom hydrophones (OBH) to detect seismic/volcanic events, successfully deployed a new autonomous hydrophone (Que-phone), made six vertical CTD casts, and made a series of high-precision pressure measurements to determine that Axial Volcano is still inflating with magma from below. We sampled hydrothermal vents from most of the known vent areas, discovered a new diffuse vent areas, including Zen Gardens (Plate 4), and finished our *ROPOS* operations by finding the largest active sulfide chimney yet seen at Axial, 13-meter high "El Guapo" with multiple boiling vents (Plate 3).

The entire ship went through a nerve-wracking experience when the AUV unexpectedly ran out of tracking range near the beginning of its first dive. It became the mission of the ship to find the AUV with a logically planned search pattern. Multiple lookouts remained on the bridge for approximately 20 consecutive hours and it was a happy moment for those who were still awake when the AUV was recovered. A very long *ROPOS* dive began the next morning and by the time it was over, the AUV team was well on the way to getting back in the water.

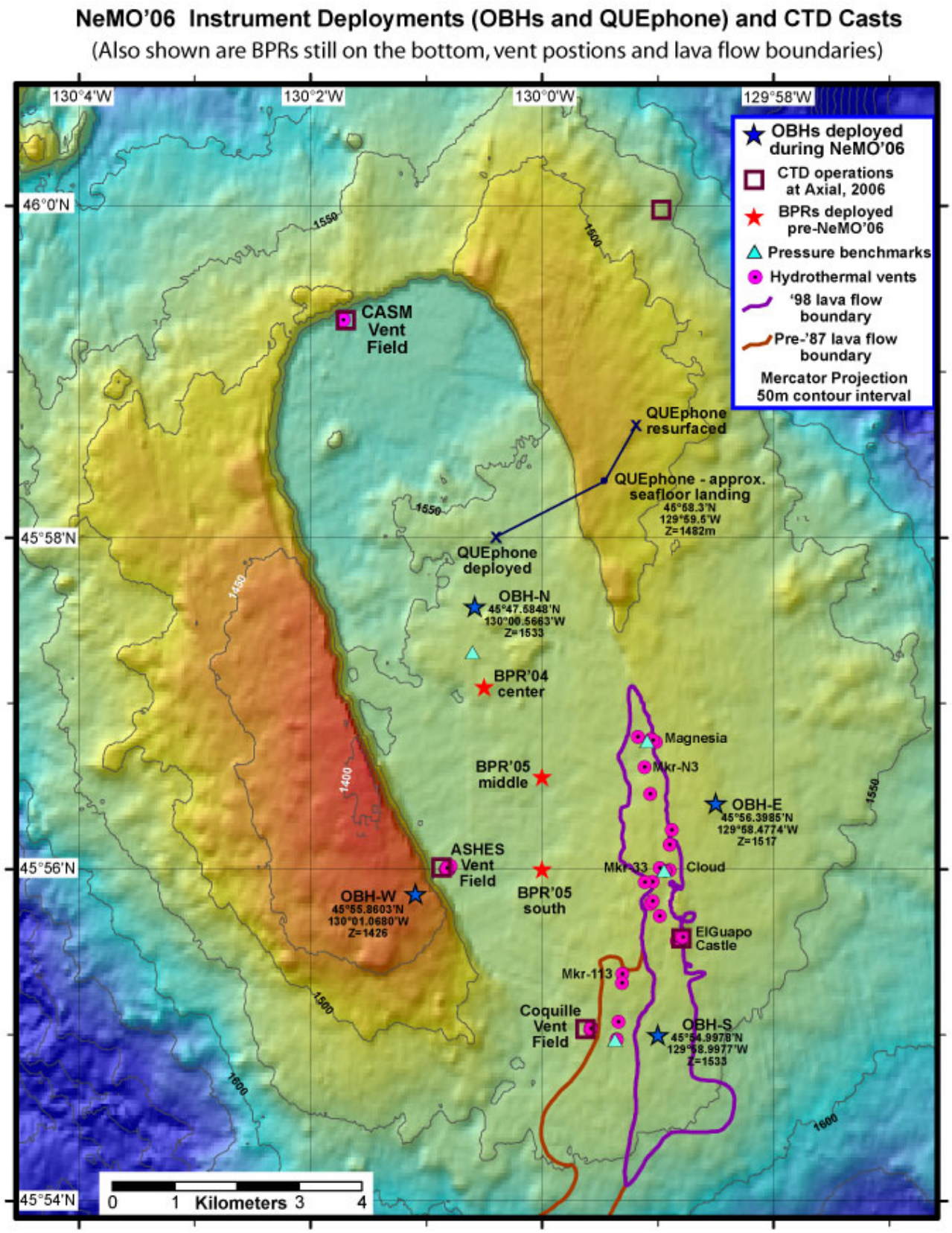
It is challenging to make efficient use of all assets when conducting combined AUV and ROV operations with no overlap in the water, along with other shipboard operations (e.g. CTD casts, launching/recovering instrument moorings). We made every effort to use all assets to the fullest extent possible. We could not launch or recover the AUV with the ROV in the water, and we required some long ROPOS dives, so there were significant blocks of time when the AUV could not be used. Furthermore, the requirement to track the AUV while it was in the water meant that the ship was not free to conduct other operations, leaving a very small window between ROV and AUV time for CTD and mooring ops. By the second week of the cruise, we settled into a workable schedule of 0800 to 2000 ROV operations and overnight AUV mapping (Figure 3), with CTD and other operations in between. It would be a tremendous advantage in the future if the AUV could be launched and left to run its course while the ship performed other operations. MBARI is working on increasing battery lifetime and

improving backup systems, but it will take additional experience at sea to develop the confidence to do fully autonomous operations.

The scientific staff for NeMO 2006 included Keith Tamburri and his team of 5 engineers (Vincent Auger, Steve Bucklew, Dan Cormany, Reuben Mills, and Dean Steinke) who kept *ROPOS* operating beyond the expectations of the scientists on board. *ROPOS* was diving within 90 minutes of arriving at Endeavour, our first area of operations, carried out a long dive the following day, then a record-breaking 53 hour dive at Axial, followed by 12-hour dives every day. The new launching system, fiber-optic data telemetry and ultra-short baseline navigation system mean better performance over an increased range of weather conditions. Significant effort went into the heavy-lift setup to recover the Rumble-ometer, and the operation went perfectly. The performance of the *ROPOS* team and vehicle was as close to flawless as you can get. The whole science team really appreciates the efforts of the *ROPOS* team to make our program work.

There were 6 scientists and engineers from MBARI on board to plan missions, operate the AUV, and produce maps from the data collected. Volcanologist David Clague, in collaboration with Bill Chadwick of PMEL, developed the mapping strategy and priorities. The entire AUV group (Dave Caress, Hans Thomas, Doug Conlin, Jenny Paduan, and Paul Tucker) performed with great confidence and tenacity in spite of adverse developments. In the end, we had five full nights of mapping, and the results are absolutely spectacular. The maps are simply the best seafloor bathymetric maps that any of us have ever seen. Having the maps available shortly after the AUV missions were completed allowed us to use them during the *ROPOS* dives to see where we were going and find features that are not visible on previous maps. For example, the plan for our last *ROPOS* dive with the fluid sampler on board was to sample multiple vent sites in the south and southeastern parts of the caldera, and especially to find sulfide chimneys that were briefly glimpsed at the end of a dive in 2004. We could actually see the sulfide structures on the AUV map, so we knew exactly where to look for the big chimneys. The combination of *ROPOS* observations and sampling with high-precision AUV mapping allows "ground-truthing" to help interpret the maps and can help to target exploratory dives.

NeMO 2006 had a talented, energetic, and congenial group of scientists and technicians on board to keep the science moving 24 hours a day by standing watch during ROV dives, dealing with instruments, and collecting and processing samples. The chemistry team was large this year, with Nathan Buck, Geoff Lebon, Leigh Evans, Andrew Opatkiewicz (also doubling as a microbiologist), Pamela Maynard, and Francoise Labonte all pitching in. The biologists included Angela Kouris (ecology of blue mats), Jonathan Rose (vent fauna), Raphaelle Dancette (Marine Protected Area study), and Sheryl Bolton (microbiology). The Marine Geology team included Bill Chadwick, Scott Nooner, Emily Laity, and Susan Merle, who was also our data czar. Bill and Susan made the web site happen with the help of Andra Bobbitt back in Newport, and contributions from shipboard participants. Engineers Jon Bumgardner and John Shanley took care of all moored instrument recoveries and deployments, and Haru Matsumoto handled the OBH surveys and Que-phone deployment. Special thanks to Bill Chadwick for his wise counsel before and throughout the cruise. We had critical shore help from Mike Hopkins, Sharon Walker, Alan Hilton, Chris Meinig, Dan Schwartz, and Mr. Tamburri of Vancouver. Captain Al McClenaghan and the entire crew of the *R/V Thompson* were utterly competent and professional and a pleasure to work with.


NeMO'06 Instrument Deployments (OBHs and QUEphone) and CTD Casts
(Also shown are BPRs still on the bottom, vent postions and lava flow boundaries)
130°4'W
130°2'W
130°0'W
129°58'W
46°0'N
45°58'N
45°56'N
45°54'N
OBHs deployed during NeMO'06
CTD operations at Axial, 2006
BPRs deployed pre-NeMO'06
Pressure benchmarks
Hydrothermal vents
'98 lava flow boundary
Pre-'87 lava flow boundary
Mercator Projection
50m contour interval
CASM Vent Field
QUEphone resurfaced
QUEphone - approx. seafloor landing
45°58.3'N
129°59.5'W
Z=1482m
QUEphone deployed
OBH-N
45°47.5848'N
130°00.5663'W
Z=1533
BPR'04 center
BPR'05 middle
Magnesia
Mkr-N3
OBH-E
45°56.3985'N
129°58.4774'W
Z=1517
ASHES Vent Field
BPR'05 south
Mkr-33
Cloud
OBH-W
45°55.8603'N
130°01.0680'W
Z=1426
ElGuapo Castle
Mkr-113
Coquille Vent Field
OBH-S
45°54.9978'N
129°58.9977'W
Z=1533
1550
1500
1450
1400
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0 1 Kilometers 3 4

Figure 1

figure 1 back

ROPOS Operations at Endeavour (Mothra and MEF), 2006

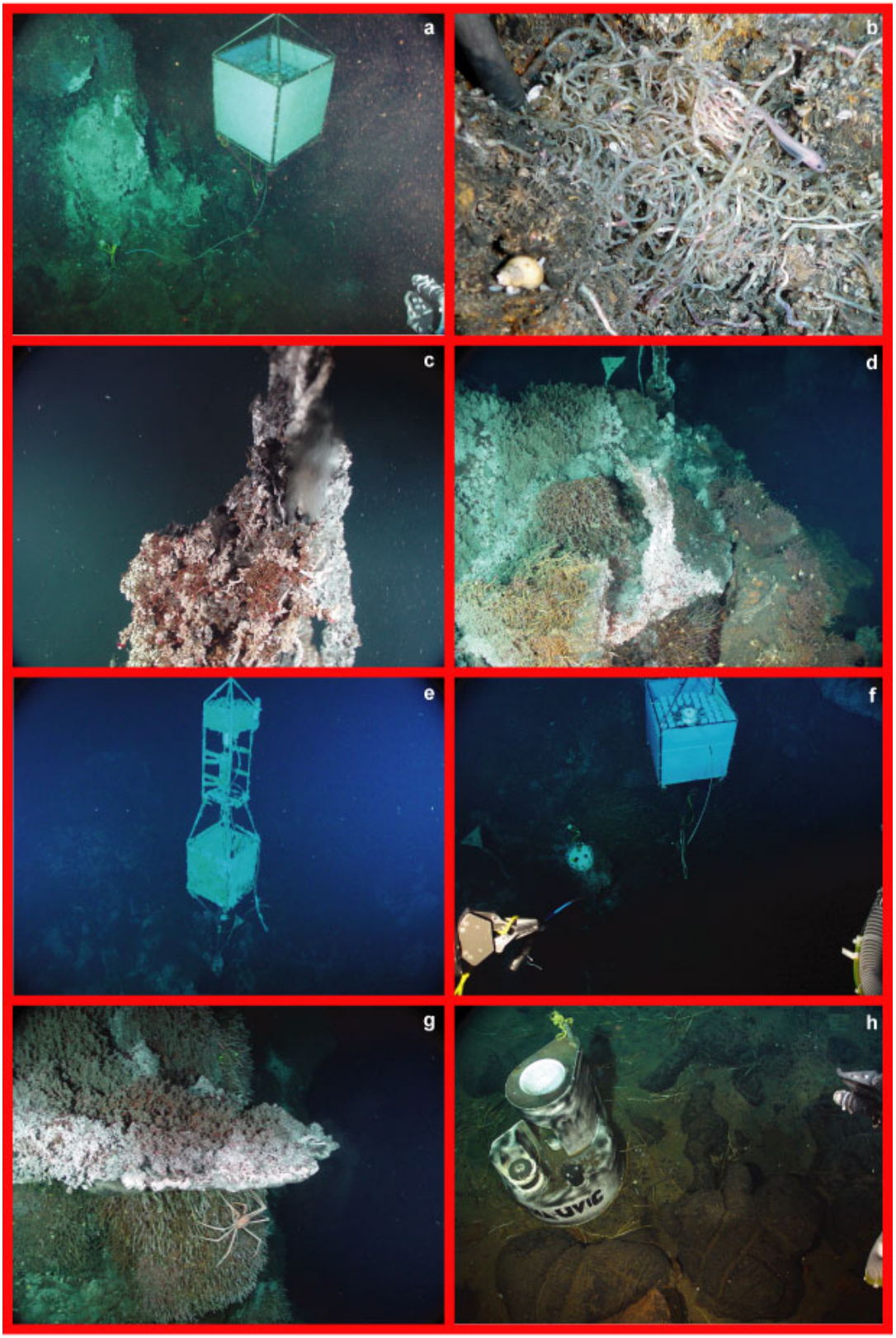

Plate 1

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ROPOS Operations at Axial, NeMO'06

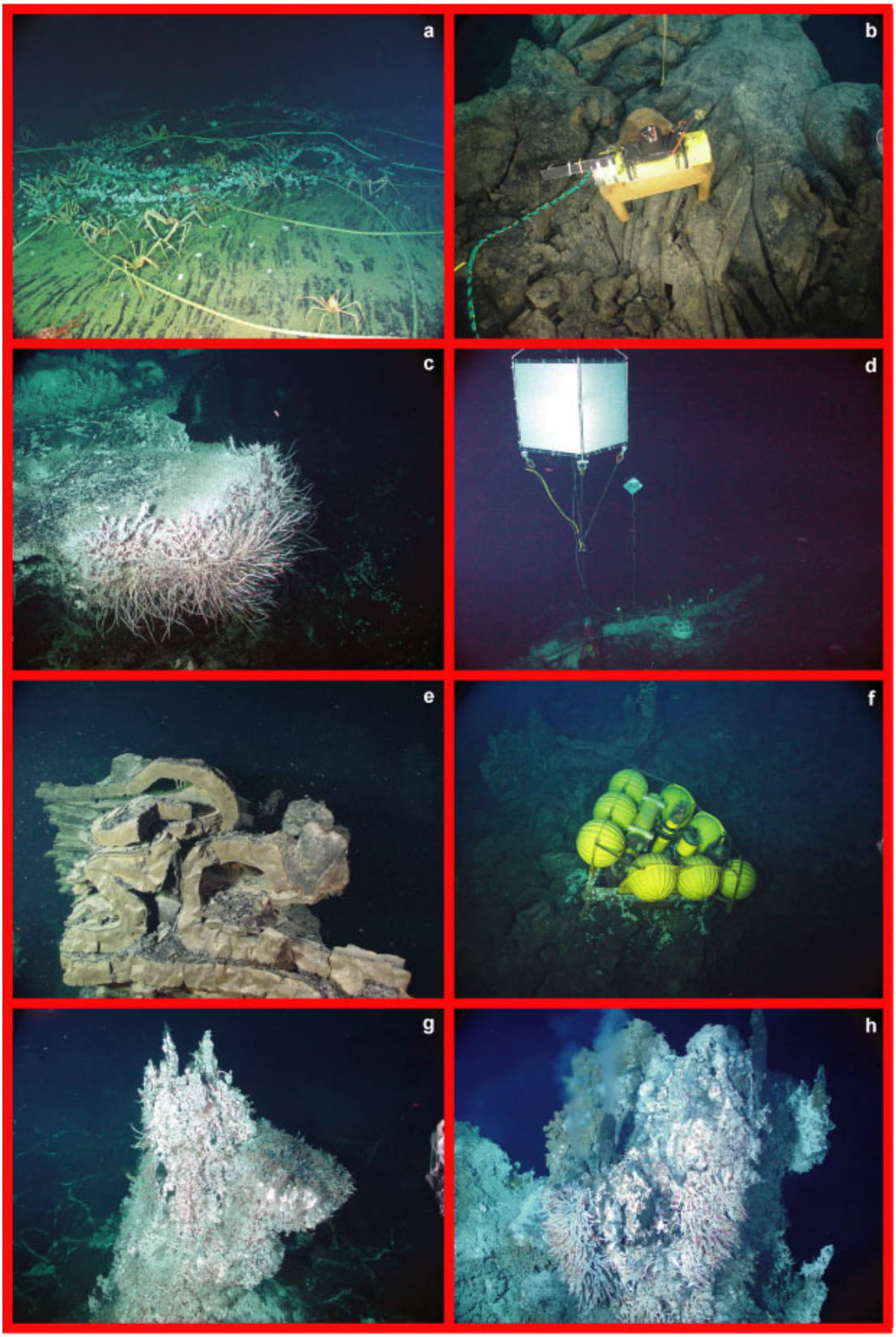

Plate 2

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The International District at Axial, NeMO'06

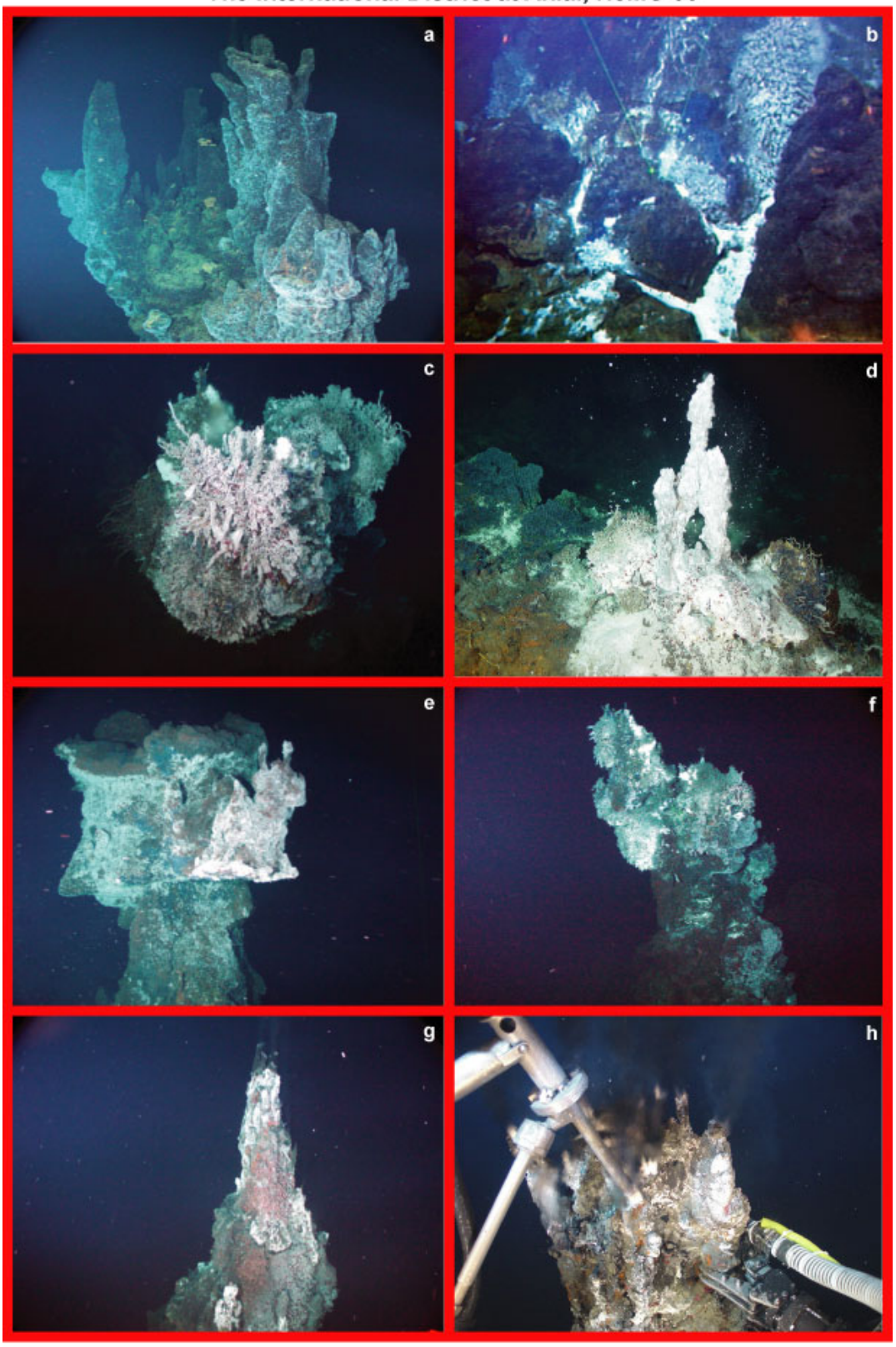

Plate 3

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Newly Discovered Diffuse Venting at Axial, NeMO'06

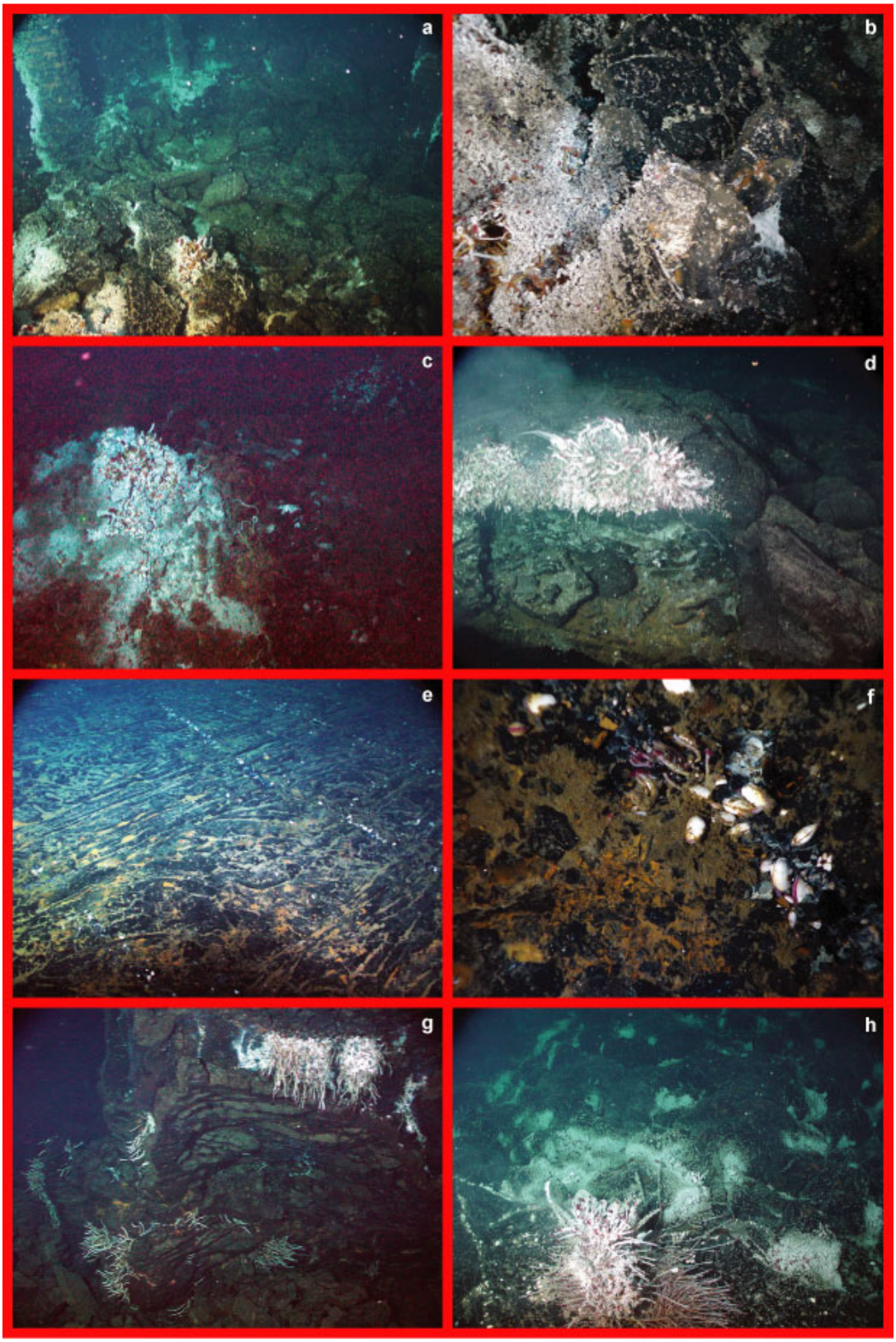

Plate 4

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1.1 OPERATIONS LOG

Date	Time (PST)	Time (UTC)	Operations Log: Comments/Event
UTC is 7 hours ahead of local time (PST)			
8/20	0900	1600	Loading science gear and installing crane for AUV launching (began 8/19).
8/21	0900	1600	Finish loading science gear, lab setup, deck preparation.
8/22	0900	1600	Thompson departs U.W. dock for transit to Victoria.
8/22	1800	0100	Arrive at Esquimalt Graving dock; some ROPOS gear loaded.
8/23	0700	1400	ROPOS loading and setup. MBARI AUV tracking transponder damaged during testing. Search for replacement/spares throughout day unsuccessful. Only option is to use ROPOS tracking gear on pole over the side.
8/24	1400	2100	Departed Victoria BC (Esquimalt Graving Dock) for the Endeavour Segment
8/25	1400	2100	Arrived at Endeavour segment - Mothra vent field
8/25	1415	2115	CTD cast over Faulty Towers at Mothra **(V06C01)**
8/25	~1645	2343	Start **ROPOS dive R1008** at **Mothra Vent Field** - Endeavour Segment
8/26	0040	0740	End dive R1008.
8/26	0130	0830	**EM300 survey of southern Endeavour segment**. Start logging. Heading 210°
8/26	0302	1002	EM300 logging off. Sonar not pinging. Communications failure.
8/26	0318	1018	Sonar back on and logging. Start EM300 line 11.
8/26	0349	1049	Turning north on EM300 survey.
8/26	0600	1300	Turning W/NW for last segment of EM300 survey
8/26	0634	1334	End of EM300 survey of southern Endeavour segment.
8/26	0945	1645	**RAS in the water over the Main Endeavour Field (MEF).**
8/26	1100	1800	Start **ROPOS dive R1009 at Main Endeavour Field**. Long-term RAS placement, Vent fluid and suction sampling.
8/26	1425	2145	RAS #17 released by ROPOS. 1500 PST at the surface. 1530 PST RAS #17 recovered.
8/27	0330	1030	End dive R1009.
8/27	0410	1110	Start transit to Axial and **EM300 survey of the Cobb Segment**.
8/27	1254	1954	**End of EM300 survey at CoAxial Segment.** Full speed ahead to Axial Caldera.
8/27	1530	2250	Arrive at Axial.
8/27	1600	2300	Start **deploying 4 PMEL OBHs at Axial**.
8/27, 8/28	1800	0100	Finished deploying 4 PMEL OBHs at Axial.
8/27, 8/28	1830	0130	NeMO Net buoy not here! Release is on its side. Later found the mooring line on the bottom but no buoy.
8/27, 8/28	1845	0145	Try the release…
8/27, 8/28	1900	0200	Survey in the OBHs.
8/27, 8/28	2330	0630	**Launch the MBARI AUV (NE of the caldera)**
8/28	~0200	~0900	**AUV veered off course and beyond tracking range.** First response was to follow last known direction, try to catch AUV and attempt to locate with tracking.
8/28	0730	1430	**AUV did not surface within range after time limit.** Set up search pattern based on starting location, last known vector, potential to change direction, and maximum range. Started running pattern at full speed with 5km line spacing.
8/28	1515	2215	Start EM300 Line 25 during search.
8/28	1525	2225	AUV search and EM300 survey. NW of the caldera now near NRZ. Traveling ~11.5 kts.

Date	Time (PST)	Time (UTC)	Operations Log: Comments/Event
8/28	1604	2304	Turning east.
8/28	1623	2323	Turning south.
8/28	1658	2358	EM300 data look sparse at this depth (Z=2625).
8/28, 8/29	2305	0605	Still searching and surveying.
8/29	0130	0830	Picked up radio signal from AUV. Faint flash seen at horizon.
8/29	0330	1030	**AUV recovered on deck!!!!**
8/29	0500	1200	Surveyed OBH1.
8/29	0715	1415	**Deployed quephone.**
8/29	0815	1515	Start **ROPOS Dive R1010** (pressure dive) Axial Caldera / South Pillow Mound.
8/31	1337	2037	End of ROPOS dive R1010. New record for a dive: > 53 hours.
8/31	1340	2040	Raise nav pole.
8/31	1430	2130	Begin **CTD at ASHES (V06C-02).**
8/31	1600	2300	End CTD at ASHES.
8/31, 9/1	1715	0015	AUV test.
8/31, 9/1	2100	0400	OBH calibration/survey.
8/31, 9/1	2300	0600	**AUV launch -1998 lava flow area.**
9/1	0600	1300	AUV recovery.
9/1	0806	1506	Begin **ROPOS dive R1011** (Northern 1998 lava flow area). HFS sampling.
9/1, 9/2	2003	0303	End ROPOS dive R1011.
9/1, 9/2	2015	0315	Begin **CTD (V06C-03) E/NE of the caldera.**
9/1, 9/2	2130	0430	End CTD (V06C-03) E/NE of caldera.
9/1, 9/2	2250	0550	**AUV dive - E/NE of caldera rim.**
9/2	0800	1514	Start **ROPOS dive R1012** (pillar dive and rumbleometer recovery.
9/2, 9/3	1900	0200	End ROPOS dive R1012. ROPOS and rumbleometer on deck.
9/2, 9/3	1930	0230	Begin **CTD at Coquille (V06C-04)**
9/2, 9/3	2200	0500	**AUV dive - S lava flow, S caldera, ASHES.**
9/3	0700	1400	AUV recovery.
9/3	0805	1505	Start **ROPOS dive R1013 at ASHES** vent field. HFS sampling.
9/3, 9/4	2015	0315	End of ROPOS dive R1013.
9/3, 9/4	2100	0400	Begin **CTD at CASM (V06C-05)**
9/3, 9/4	2300	0600	**AUV dive - N Rift Zone with tie line down the E side of the caldera rim thru 98 flow to Vixen.**
9/4	0740	1440	AUV recovery.
9/4	0810	1510	Begin **ROPOS dive R1014** (Vixen, Bag City, Mkr-113, Castle, International District). HFS sampling.
9/4, 9/5	2006	0306	End ROPOS dive R1014.
9/4, 9/5	2015	0315	**CTD at Castle area (V06C-06)**
9/4, 9/5	2200	0500	**AUV dive - One tie line from Castle area over to Mkr-113 and north to NE caldera floor.**
9/5	0620	1320	AUV on deck.
9/5	0700	1400	Departed Axial for Victoria BC.

Date	Time (PST)	Time (UTC)	Operations Log: Comments/Event
9/6	1200	1700	Arrive in Victoria BC to offload ROPOS and Canadian science gear
9/6	2300	0600	Depart Victoria for Seattle overnight
9/7	1200	1900	Arrive at University of Washington pier, Seattle, WA
9/8	1200	1900	Offloading and cleanup complete. Next voyage starts loading.

2.0 CRUISE PARTICIPANTS

PARTICIPATING ORGANIZATIONS

- NOAA – Pacific Marine Environmental Lab (PMEL)
- University of Washington – Joint Institute for Study of the Atmosphere and the Ocean (JISAO)
- Oregon State University – Cooperative Institute for Marine Resource Studies (CIMRS)
- Monterrey Bay Aquarium Research Institute (MBARI)
- Scripps Institution of Oceanography (SIO)
- University of Victoria, British Columbia (UVIC)
- University of Quebec at Montreal (UQAM)
- Canadian Scientific Submersible Facility (CSSF)

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3.0 NeMO 2006 DISCIPLINE SUMMARIES

3.1 ACOUSTICS

3.1.1 Monitoring Axial Volcano with OBHs and the QUEphone: NeMO'06

Haru Matsumoto (CIMRS)

OBH deployments

Deploying OBHs (Ocean Bottom Hydrophone) at Axial Volcano allows us to investigate the source mechanism of seismicity at much closer range than previously could be accomplished by a distant fixed hydrophone network. During the NeMO'06 cruise, a total of four OBHs were deployed at the mooring locations shown on Figure 1 (blue stars). The new OBH platform, while providing a good coupling to the ground, is designed to protect the hydrophone and the internal electronics against damages that might occur during deployments and recoveries. Each mooring consists of a bottom anchor plate, an aluminum platform, an acoustic release, and a 35 meter long tether with 8 glass spheres.

The followings are the codes associated to the EG&G acoustic releases for each mooring.

Name	Ser #	Release code	Disable Code	Enable code	Int Freq	Reply Freq
OBHN	30636	142507	137617	137575	11.0kHz	12.0kHz
OBHS	30537	133356	117071	117052	11.0kHz	12.0kHz
OBSE	015701	532302	535742	535761	11.0kHz	10.0kHz
OBSW	023772	634376	655441	655407	11.0kHz	12.0kHz

After the deployments, all four OBHs were triangulated using the "Workboat" program, and all acoustic releases were confirmed disabled. The logging computers of the OBHs were programmed in the Newport lab prior to the cruise so that the acoustic monitoring would start on 9/06/2006 (GMT), approximately one day after our departure of the area at the end of the cruise. Because of the uncertainty of the future recovery cruise schedule, we have prepared the batteries and the data storages appropriately large enough for up to two years of continuous monitoring.

QUEphone

While a ROPOS ROV dive was in progress, a new pseudo real-time hydrophone, called "QUEphone" (QUasi-Eulerian phone), was tested at Axial. The test dive started on 8/29 at 1404 (GMT) at the northeast side of caldera, approximately 1km off the center of the caldera. It took 9 hours to descend to the bottom. The instrument, upon arrival on the bottom, started an 8-hour long acoustic monitoring. Although it is capable of monitoring up to one month and 12 dives, considering the time frame and other higher priority missions during the cruise, we programmed it to monitor for a relatively short period and limited it to only one dive. At 06:20 on 8/30, it ended the acoustic monitoring, started its ascent, and 5 hours later reached the surface.

During the 8-hour monitoring period the QUEphone detected one T-phase at 242:04:56:38 +/-5 sec (GMT). The epicenter of the earthquake will be investigated by incorporating the SOSUS real- time data. At this point, it appears to be the origin of a distant earthquake. The QUEphone also recorded continuous mechanical noises from ROPOS and the *R/V Thompson*. Both were in operation in close range. The local seismicity appeared to be quiet during the time of monitoring and no other T-phases were detected (Figure 2a).

The QUEphone re-surfaced 2.4km to the northeast of where the dive began (Figure 2b). A straight line interpolation and the depth record suggest that it landed at the northeastern flank of Axial volcano slope, approximately at N45^{o}58.3-W129^{o}59.5, where the seafloor surface is sediment covered (from the past ROV

observations). The pressure gauge indicated that its depth was between 1482 m and 1484m while on the bottom, which was consistent with the bathymetry and tidal data at those coordinates.

Upon completion of the dive, it transmitted short acoustic data from an Iridium modem; subsequently at every a half hour interval it updated its coordinates at the PMEL Iridium web site. With a few minutes of delay, aboard the *R/V Thompson* we were able to retrieve the acoustic data and continue to track the QUEphone position until it was recovered. The test was a success, and all the components worked as designed including the Iridium/GPS communication module and deep water antenna, buoyancy controller, hydrophone, and data logger/processor.

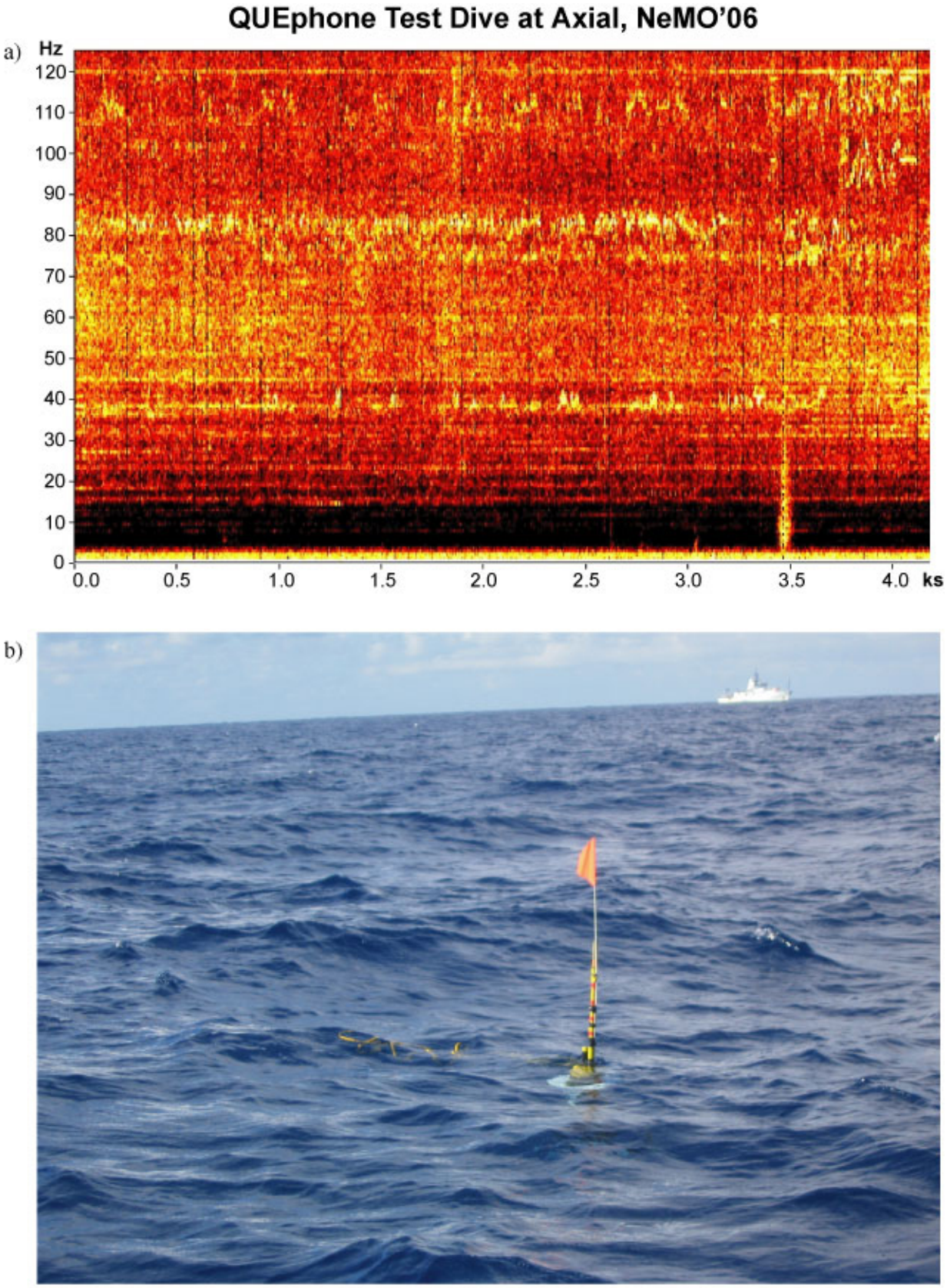
a)
QUEphone Test Dive at Axial, NeMO'06
Hz
120
110
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
ks
b)

Figure 2

figure 2 back

3.2 BIOLOGY

3.2.1 Biology Experiments and Insights at Endeavour and Axial

Jonathan Rose (UVic)

Parasitism of Vent Limpets

Parasitism is a common mode of existence and examples of it are found in virtually all ecosystems studied. However at the hydrothermal vents there have been few recorded samples found and most of those were either unidentified or a normal deep-sea parasite. Recently a type of parasitic copepod (Family: Nucellicolidae) has been discovered on the hydrothermal vent limpet *Lepetodrilus fucensis*. *L. fucensis* is the most abundant organism on the Juan de Fuca ridge system. The parasite is a new species that is currently being described. Suction samples of limpets were done at several locations to be processed back in the lab looking for the parasite.

Larval Recruitment

There are several ongoing studies of larval recruitment at hydrothermal vents. The sometimes massive but highly localized movement of water could allow for a number of potentially interesting recruitment strategies. On August 20, 2003 a Technicap sediment trap was deployed on the edge of Easter Island vent at the Main field on the Endeavour segment. Easter Island is a large diffuse vent just to the east of the talus slope. The trap consists of a cone with a 24-bottle rosette at the bottom and was programmed for a 2-week rotation thereby sampling almost an entire year. It was scheduled for recovery in 2004 and 2005 but due to weather or other unforeseen circumstances this was not done. Recovery this year was going smoothly until 30m from the surface. ROPOS was in the midst of surface recovery operations and must have hit an odd swell. The sediment trap tilted a bit in the grasp of the Magnum 7-Function manipulator, which then lost its grip on the trap. The trap tilted over and sank to the bottom. We did not have time to go back and recover the trap as it is a 2 hour descent and another 2 hour ascent. Unfortunately as the trap went down headfirst it is reasonable to assume that the samples collected and the trap itself are lost.

Deepsea Wood Communities

Over the past number of years, at numerous locations in the NE Pacific, wood has been deployed in an effort to collect wood boring bivalves. Historically there has been only one described species of deep-sea wood boring clams - *Xylophaga washingtona*. In the course of the wood collections several new species have been discovered and are in the process of being described. A wood block deployed approximately 20m north of Marker 33 vent was recovered and preserved. This wood was deployed in 2002 or 2003 so not much remained of the original 12" long 4x4 of fir. There looked to be some clams remaining in the wood fragments which were presevered. The associated fauna was also collected and preserved.

Limpet Growth Rates

On the NeMO 2004 cruise an exclusion cage was deployed for Noreen Kelly at Dalhousie. The experiment was to determine the growth rate of some *L. fucensis* by means of labeling the shell and then recovering after a period of time. Just releasing the limpets back at the vent would not work, as it would be next to impossible to recover the labeled individuals so they were placed in a cage. The cage was designed to allow fluid flow to pass through but the limpets should remain behind.

Sulphide Weathering Experiment

The purpose of this work was to document the characteristics of submarine sulfide weathering and determine the role of bacteria in this process. Pieces of sulfide were deployed in 2003 in pieces of tubing. Standard mineralogical and chemical characterization of these altered sulfides will be undertaken in laboratories at the Université du Québec à Montréal and McGill University. Cell counting, biomass estimates and molecular techniques (DNA-based phylogeny) will also be used to assess the nature and abundance of bacteria in these

samples and their possible role in the alteration of the sulfide minerals. Ratios of the stable isotopes of iron will be determined by MC-ICP-MS and their potential use as a biomarker will be critically assessed.

3.2.2 Identification and Characterization of Blue Mat (*Folliculinopsis* sp.) Ciliate Symbionts from Northeast Pacific Hydrothermal Vents

Angela Kouris (UQAM), Kim Juniper (UVic), Nicole Dubilier (Max Planck Institute)

Dense blue-green coloured protozoan mats adjacent to hydrothermal venting on Axial Volcano of the Juan de Fuca Ridge, northeast Pacific, were first reported in the literature twenty years ago. Though relatively little is known about the ecology and biology of these protozoa, carpets of folliculinid ciliates (Blue Mats) still occur on Axial Volcano, and are now known from other vent sites in the northeast Pacific, indicating that they are a recurrent component of the vent fauna in this region.

In 2005, the ultrastructure of the Blue Mat ciliates was investigated in samples collected from Axial Volcano using conventional scanning electron microscopy (SEM) and thin section transmission electron microscopy (TEM). Results of this study suggest the existence of at least an endosymbiosis between Blue Mat (*Folliculinopsis* sp.) ciliates and bacteria at hydrothermal vents (Kouris, A. *et al* -in press). The chemolithoautotrophic nature of these symbiotic bacteria remains to be confirmed. Complementary molecular analysis (16SrRNA gene analysis and fluorescent in situ hybridization) will be performed during a three month MarMic Early Stage Training research internship (A.K.) at the Max Planck Institute of Microbiology (Bremen, Germany) to determine the microbial diversity, location in the host cell and phylogenetic position of the microorganisms associated to the Blue Mats. Sequencing Blue Mat symbiont genes, for example, may show that these microorganisms, like bacterial symbionts common in invertebrates living in reducing environments such as hydrothermal vents, whale falls, cold seeps and sunken wood, are related to either sulfur-oxidizers (thiotrophic), methane oxidizers (methanotrophic) or both and thus provide us with clues to their metabolism. Suction samples of Blue Mats were collected from five hydrothermal vent sites at Axial Volcano (Marker N3, Diva, Mushroom, Village, Phoenix) for this molecular biological work using the ROPOS ROV (August – September, 2006).
To our knowledge, ours was the first reported protozoan-bacterial symbiosis at vents as well as the first reported symbiosis in folliculinid ciliates. Further, no other study has investigated the molecular biology of bacterial symbionts in folliculinid ciliates.

3.2.2a Axial Blue Mat Samples (NeMO 2006)

Dive #	Vent	FISH	rRNA
R1010 SS J4	Villace	3x 15ml tubes	1x 15ml 1x 50ml
R1011 SS J3	Mkr-N3	3x 15ml tubes	2x 50ml
R1011 SS J4	Mkr-N3 periphery		
R1013 SS J3	Mushroom	3x 15ml tubes	1x 50ml
R1013 SS J4	Phoenix	3x 15ml tubes	1x 50ml
R1014 SS J3	Diva	3x 15ml tubes	1x 50ml

3.2.3 Managing Scientific Research Activities in the Endeavour Hydrothermal Vents Marine Protected Area - Comparison with the Axial Volcano Site, Situated in International Waters

Raphaelle Dancette (UQAM)

The primary aim of my Master's project in Environmental Science is to document the location, type and intensity of scientific research activities within the Main Endeavour hydrothermal field and to compare it with the activities

led at Axial volcano. The NeMO'06 cruise allowed me to observe the locations, methods and timescales of scientific sampling and observations. We used the Canadian operated submersible ROPOS. It has also provided me with an opportunity to directly observe sampling and instrument deployment operations, including the interaction between scientists and submersible pilots. Another aspect of my study is to determine the present and expected activities, and how scientists take into consideration the environmental concerns when planning and carrying out research. This includes the perception of the scientists on the impact they have. To accomplish that, I asked the scientists and the ROPOS team to fill out a questionnaire about their sampling methods and their general knowledge about Endeavour. A secondary aim is to study the principal faunal habitats within the different areas of scientific activities in order to determine which faunal communities are most directly affected by human intervention. This information will be used in an upcoming revision of management zones within the Endeavour Marine Protected Area (MPA). Most of the information for my MSc project (concerning scientific activities as well as the faunal assemblages) will come from reviewing navigation logs, numerical pictures and video records from the NeMO'06 cruise.

The tracklines followed by the ROPOS submersible in this cruise to Endeavour, together with the same information from previous cruises at the same site will be entered into a GIS database that I am developing in order to determine where the submersible passes the most frequently. I will then study the types of macrofauna found around those areas since these organisms are potentially affected by the environmental pressure caused by repetitive modification of their habitat. The lights and noise (due to the sonar and propellers) of the submersible and ship will also be taken into consideration as factors altering the natural environment of the studied ecosystems.

Another impact that scientific activities can have at sea is of aesthetical concern. For example, ship and sampling garbage left on the bottom have a visual impact on these otherwise pristine areas, particularly for the Endeavour MPA. . Over time, this could affect public opinion on the importance of protecting the marine environment. I took video and picture samples of the objects that we saw that did not facilitate any present studies. I also asked officers of the *R/V Thompson* to explain to me the policies for waste disposal on board and how that compares to what is practiced.

3.3 GEOLOGY

3.3.1 Pillar Sampling and Repeated Pressure Measurements

Bill Chadwick (CIMRS), Scott Nooner (SIO), and Emily Laity (SUNY)

Pressure measurements have been made at Axial seamount since 2000 in order to see if the volcano has been re-inflating since its eruption in 1998. These measurements are among the first to attempt to measure vertical deformation on an active submarine volcano. Previous results have shown that the volcano appeared to be inflating up to 19 cm/yr, but our measurement errors have decreased each year, so there is some uncertainty in the long-term rate.

The pressure measurements this year were made on ROPOS dive R1010, from 19:30 UTM on 8/29/06 to 18:30 UTM on 8/31/06, a 53.5 hour dive (the longest ROPOS dive to date)! The 2006 survey was carried out in precisely the same way as the 2004 survey. Previous surveys have only taken 36-40 hours. The extra dive time required this year was mainly due to changes in the ROPOS system since 2004. Without the cage, ROPOS now has to drag the weight of its cable through the water during transits, and the maximum transit speed was only about 0.8 knots at best. Because the pressure transects include several long transits, this increased the dive time considerably. Also, we started the dive by examining the anchor of the missing NeMO Net buoy, and errors in the ultra-short baseline navigation during the dive caused offsets in the navigation, so extra time was needed to find each benchmark. In future surveys this time should be significantly less, but we estimate that a minimum of 40 hours is required to make 3 transects with the new ROPOS system (without doing any other tasks).

Measurements were made by placing the MPR (mobile pressure recorder) on top of benchmarks that were deployed in 1999. As in 2004, the pressure sensor had a flat plate on the bottom to make the exact orientation of the sensor repeatable from measurement to measurement. The sensor was also aligned with a specific side of each triangular benchmark, again to increase repeatability. Data collection was the same as in 2004, but this year we recorded only 20 minutes at each site rather than 30 minutes. Data was recorded on a laptop PC in the ROPOS control room running LabView software. Measurements were made on five benchmarks (AX63-Caldera Center, AX01-Magnesia, AX05-Marker 33, AX04-Bag City, and AX66-Pillow Mound). AX01, AX05, and AX04 were visited three times each, while AX 63 and AX66 were visited twice each. AX66 is the reference benchmark and is outside the area of expected deformation. The pressure data was converted to depth then corrected for tides using the worldwide tide model SPOTL. The uncertainty in the measurements is given by the scatter of repeated measurements at each benchmark. The repeatability this year was 1.4 cm. The repeatability will be slightly improved by using real tide data from nearby BPR's (Bottom Pressure Recorders) when that data becomes available.

Comparing the 2006 depths to previous years shows that inflation is continuing in the caldera relative to AX66. Benchmark AX63 at the center of the caldera was uplifted by about 21 cm since 2004, and a linear trend since 2000 suggests an uplift rate of about 13.5 cm/yr. However, a linear inflation trend does not fit the data well over the entire 6 years, and suggests that the rate of inflation may be decreasing with time. The observed rate of inflation also decreases with radial distance from the caldera center, as is expected.

Another of the geology goals this year was to make several transects to examine the distribution of lava pillars within the 1998 lava flow, and to sample some of the pillars both within and off the 1998 flow. This sampling effort was a follow-up to a single pillar sample obtained in 2003 (R743-RK-0007) that was found to have very unusual chemistry. In particular, the glass that lines the interior of the pillar was found to have rare evidence for lava/seawater interaction. This kind of interaction has not been seen in other pillar samples. By sampling additional pillars, we want to see if this is unique to pillars in the 1998 flow, or perhaps Axial in general, or was just a fluke occurrence. This year, we obtained five additional pillar samples (R1012-pillar-0001, -0002, -0005, -

0006, and R1014-pillar-0001) to compare with the 2003 sample. The chemical analysis is being done in collaboration with Peter Schiffman and Rob Zierenberg at UC Davis.

3.3.1a Axial Pressure Benchmark Positions and Depths

benchmark	longitude °W	latitude °N	z (m)
AX-63 (Caldera)	-130.010050	45.955150	1530
AX-05 (M33)	-129.98245	45.933250	1523
AX-04 (Bag City)	-129.989450	45.916183	1534
AX-66(S. Pil. Mound)	-130.003720	45.863150	1723
AX-01 BM Magnesia	-129.984900	45.946217	1524

3.3.2 MBARI Mapping Autonomous Underwater Vehicle (AUV) Surveys at Axial

Dave Clague (MBARI)

During the 2006 NeMO cruise on the *R/V Thompson*, the MBARI Mapping Autonomous Underwater Vehicle (AUV) was deployed for 6 surveys on Axial Seamount (Figure 2). The objectives of the survey were to determine the geologic history of the summit of Axial Seamount and to locate optimal fiber-optic cable routes for a future observatory. (Figures 4 and 5)

The Mapping AUV is a torpedo-shaped, 6000 m rated vehicle designed and constructed by MBARI. The vehicle is equipped with a 200 kHz multibeam sonar, 110 kHz and 410 kHz chirp sidescan sonar, and a 2-16 kHz sweep chirp sub-bottom profiler. The multibeam provides a 120-degree swath with 0.94 degree by 0.94 degree beam resolution. The endurance of the AUV is eight hours at 3 knots. Navigation derives from an inertial navigation system (INS) incorporating a ring laser gyro aided by GPS at the surface and by velocity-over-ground observations from a Doppler velocity log (DVL) when within 130 m of the seafloor. A navigational precision of 0.05% of distance traveled is achieved with continuous DVL bottom lock. An acoustic modem allows surface aiding of navigation during deep descents.

The AUV ran two types of missions: those on the rim of the caldera were run at 90 m altitude with a line spacing of 250 m and those on the caldera floor were run at 50 m altitude with a line spacing of 150 or 175 m. Missions were of 7-8 hrs duration, including decent and ascent, and were all done at night after the ROPOS ROV was recovered and the daily CTD cast completed. The first deployment suffered a malfunction and the vehicle veered off the planned mission and was recovered after surfacing after the mission aborted. After evaluating the problem, we launched a sequence of 5 missions, one each night until the end of the cruise.

The surveys covered most of 1998 lava flow on the south rim of the caldera and northern part of the south rift zone, the southern region of the caldera floor where hydrothermal vents are common, the northeast rim of the caldera where volcaniclastic deposits related to caldera collapse drape the surface, the north rift zone, and the northern portion of the caldera floor. The surveys run at 50 meter altitude have a resolution of one meter so that large individual lava pillars (Figure 6) and hydrothermal chimneys (Figure 7) can be seen, fissures stand out clearly, and the regions of collapsed lobate flows can be mapped. Many of the flows, including the 1998 flow, have dramatic drained lava ponds and channel distributary systems that closely resemble on-land flow channels (Figure 8). The northeast rim of the caldera is cut by numerous fissures, some of which served as eruptive vents for post-caldera flows that are on top of the volcaniclastic deposits. The CHIRP sub-bottom profiler did not resolve the roughly 2-m thick deposits observed and sampled with a vibracorer during an MBARI Tiburon ROV dive in early August 2006. The north rift zone has prominent fissures near the caldera, but within about 1.5 kilometers of the caldera rim, the fissure system is less obvious, having been buried by young flows. The north rift zone is a constructional ridge that is cut by numerous fissures, but both die out within 1.6 km of the caldera wall. Northeast trending fissures are present about 1-1.5 km east of the north rift zone as well. The survey of the

caldera floor imaged a small volcanic cone with a 62 m wide, 39 m deep, crater in the center. In addition, a lobate flow along the base of the northeastern caldera wall has 9 collapse pits, 10-50 m across and 7-13 m deep, aligned like skylights along a tube system on subaerial flows. Nearby to the northwest, there is a flat lava pond with a bathtub ring of lava around it that is 3 m shallower than the pond surface. The 900 m wide flat surface and the rim are both tilted with the side closest to the center of the caldera about 1.5 m shallower than the northeastern corner of the pond. Fifteen round 5 m tall, 10-40 m diameter mounds of unknown origin (sulfide mounds or tumulus?) are scattered on the flow surface. We mapped all of the known hydrothermal vent sites in and near the caldera on Axial Seamount. These sites have been the focus of the NOAA Vents Program for many years and the new high-resolution maps will place these sites in known geologic settings. In addition, as we have time to examine the new maps in detail, we expect to find new chimneys and undiscovered hydrothermal fields.

My research at MBARI is presently focused on caldera formation and eruptive dynamics. The new mapping data, coupled with samples collected during this and previous cruises, will help us determine the emplacement histories of the 1998 flow and earlier flows, and will define the extent of explosive eruption deposits that accompanied the collapse of the present-day caldera. The AUV generates high-resolution maps for geologic analysis not possible using previous mapping systems.

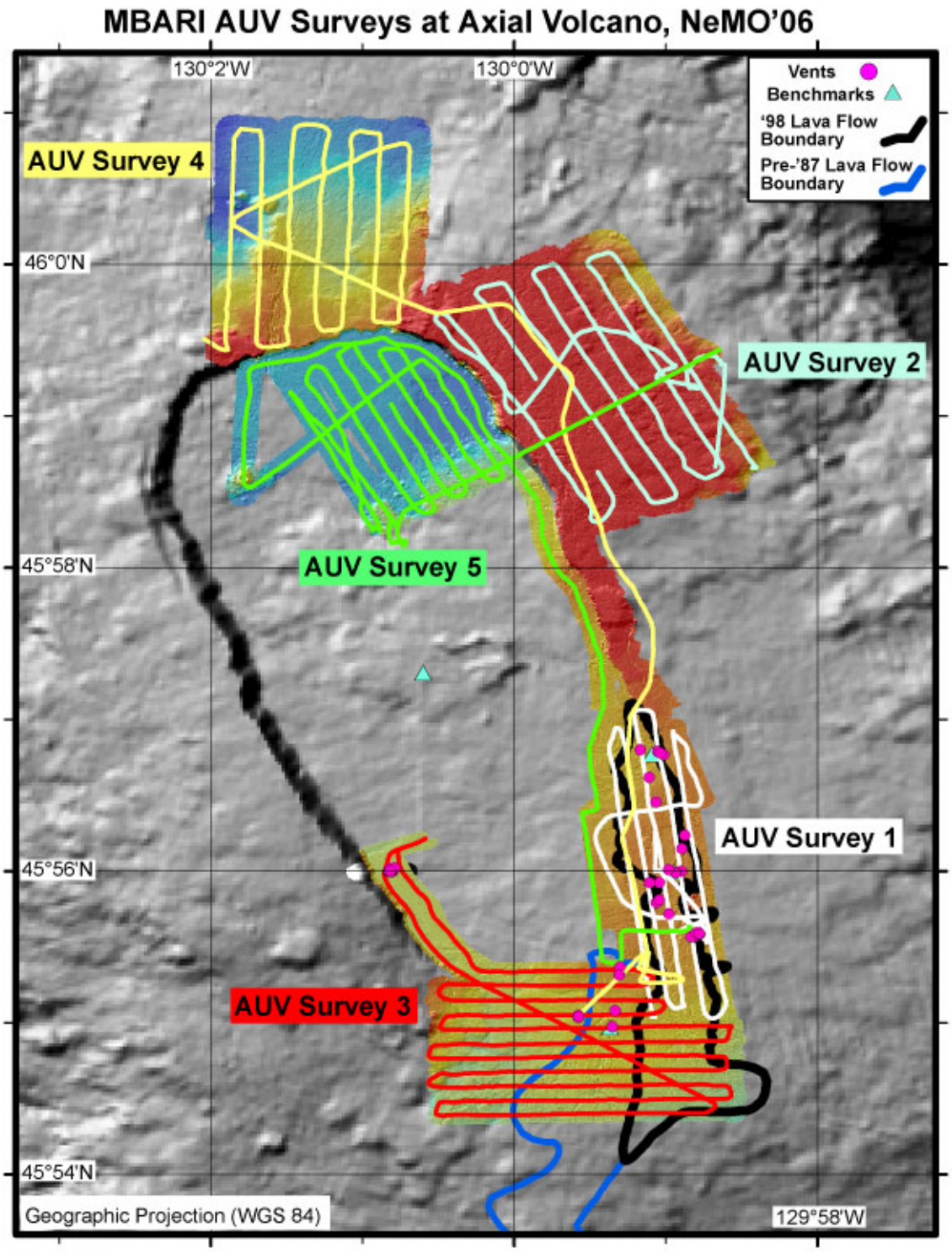
MBARI AUV Surveys at Axial Volcano, NeMO'06
130°2'W
130°0'W
Vents
Benchmarks
'98 Lava Flow Boundary
Pre-'87 Lava Flow Boundary
AUV Survey 4
AUV Survey 2
AUV Survey 5
AUV Survey 1
AUV Survey 3
46°0'N
45°58'N
45°56'N
45°54'N
Geographic Projection (WGS 84)
129°58'W

Figure 3

figure 3 back

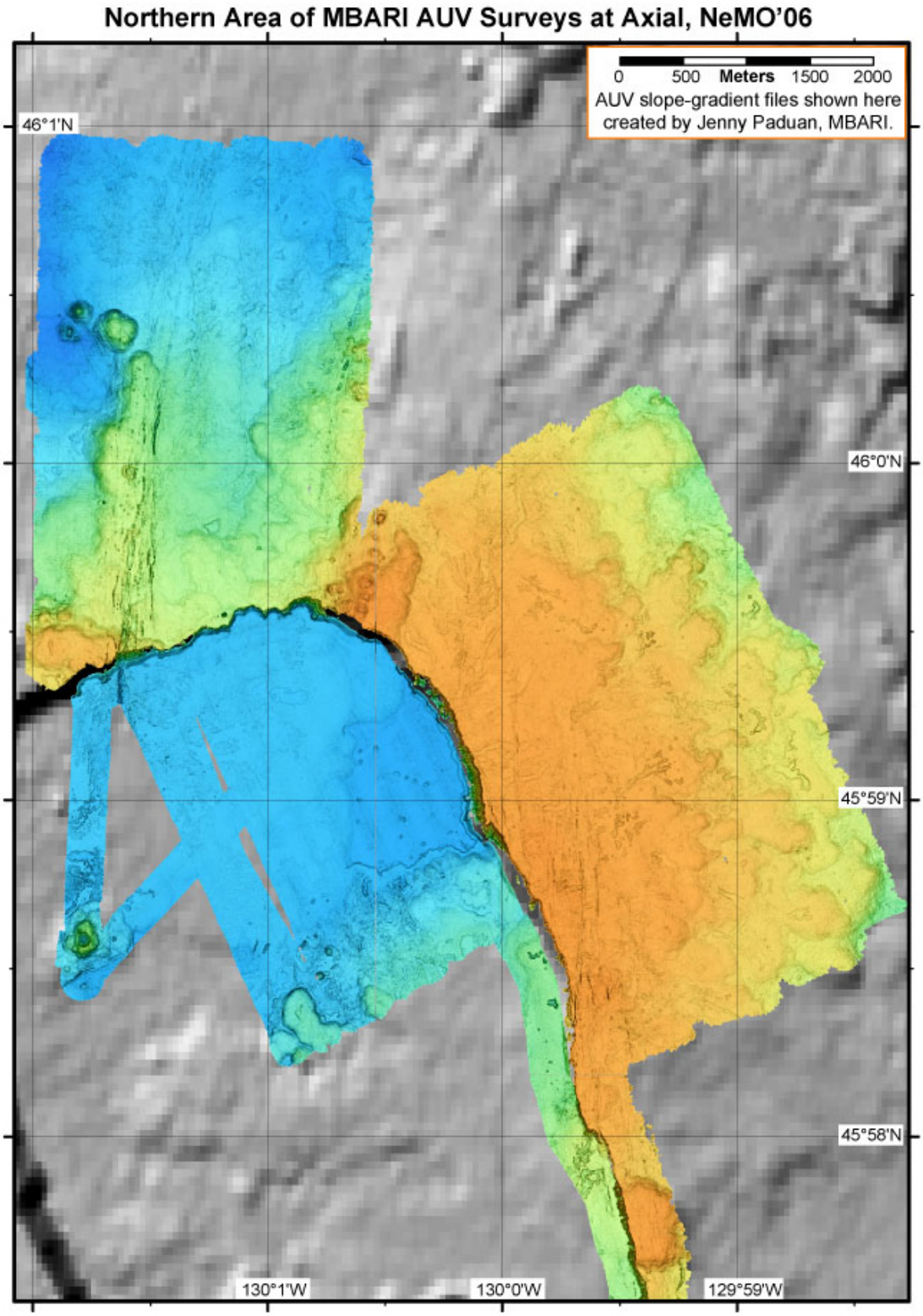
Northern Area of MBARI AUV Surveys at Axial, NeMO'06
0 500 Meters 1500 2000
AUV slope-gradient files shown here
created by Jenny Paduan, MBARI.
46°1'N
46°0'N
45°59'N
45°58'N
130°1'W
130°0'W
129°59'W

Figure 4

figure 4 back

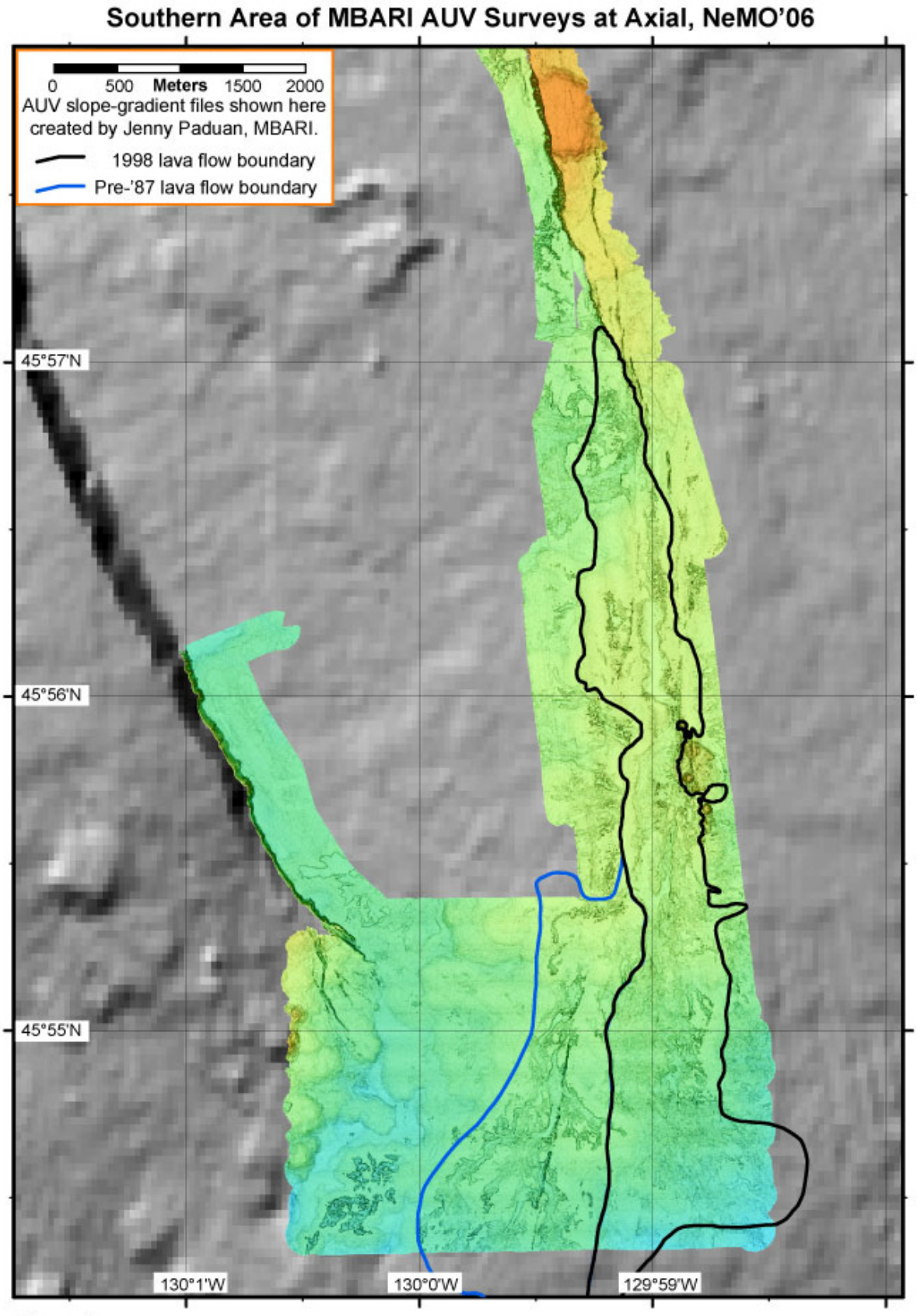
Southern Area of MBARI AUV Surveys at Axial, NeMO'06
0 500 Meters 1500 2000
AUV slope-gradient files shown here created by Jenny Paduan, MBARI.
1998 lava flow boundary
Pre-'87 lava flow boundary
45°57'N
45°56'N
45°55'N
130°1'W
130°0'W
129°59'W

Figure 5

figure 5 back

Figure 6

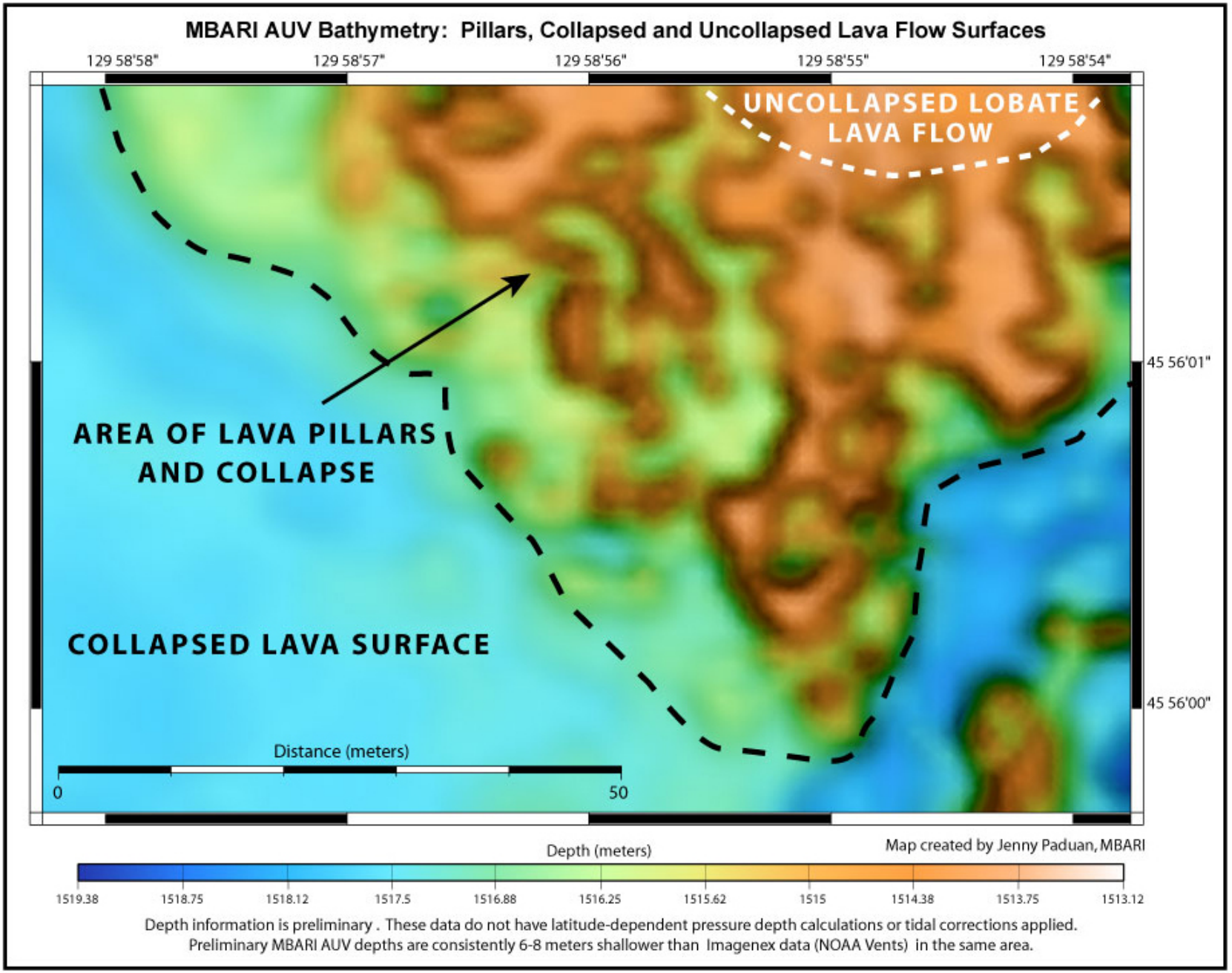
MBARI AUV Bathymetry: Pillars, Collapsed and Uncollapsed Lava Flow Surfaces
129 58'58"
129 58'57"
129 58'56"
129 58'55"
129 58'54"
UNCOLLAPSED LOBATE LAVA FLOW
AREA OF LAVA PILLARS AND COLLAPSE
COLLAPSED LAVA SURFACE
45 56'01"
45 56'00"
Distance (meters)
0
50
Depth (meters)
1519.38
1518.75
1518.12
1517.5
1516.88
1516.25
1515.62
1515
1514.38
1513.75
1513.12
Map created by Jenny Paduan, MBARI
Depth information is preliminary . These data do not have latitude-dependent pressure depth calculations or tidal corrections applied.
Preliminary MBARI AUV depths are consistently 6-8 meters shallower than Imagenex data (NOAA Vents) in the same area.

figure 6 back

Figure 7

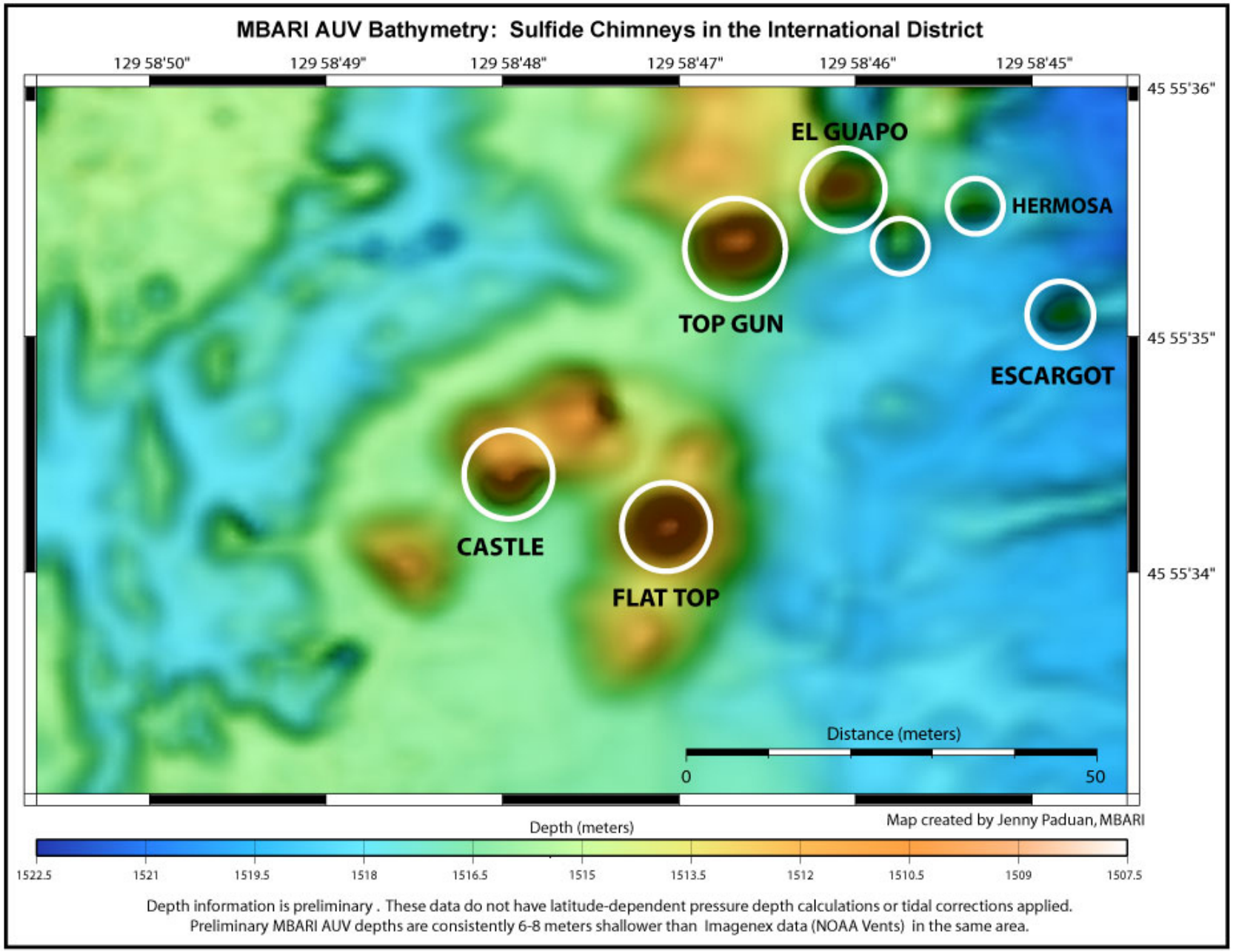
MBARI AUV Bathymetry: Sulfide Chimneys in the International District
129 58'50"
129 58'49"
129 58'48"
129 58'47"
129 58'46"
129 58'45"
45 55'36"
45 55'35"
45 55'34"
EL GUAPO
HERMOSA
TOP GUN
ESCARGOT
CASTLE
FLAT TOP
Distance (meters)
0
50
Map created by Jenny Paduan, MBARI
Depth (meters)
1522.5
1521
1519.5
1518
1516.5
1515
1513.5
1512
1510.5
1509
1507.5
Depth information is preliminary . These data do not have latitude-dependent pressure depth calculations or tidal corrections applied.
Preliminary MBARI AUV depths are consistently 6-8 meters shallower than Imagenex data (NOAA Vents) in the same area.

figure 7 back

MBARI AUV Bathymetry: Lava Drainage Chennels and Fissures
129 59'40"
129 59'35"
129 59'30"
129 59'25"
129 59'20"
129 59'15"
129 59'10"
45 54'50"
45 54'45"
45 54'40"
Distance (meters)
0
100
200
LAVA DRAINAGE CHANNEL
FISSURES
Depth (meters)
1548
1546
1544
1542
1540
1538
1536
1534
1532
1530
1528
Map created by Jenny Paduan, MBARI
Depth information is preliminary . These data do not have latitude-dependent pressure depth calculations or tidal corrections applied.
Preliminary MBARI AUV depths are consistently 6-8 meters shallower than Imagenex data (NOAA Vents) in the same area.

Figure 8

figure 8 back

3.3.3 *R/V Thompson* EM300 Bathymetric Surveys

Susan Merle and Bill Chadwick (CIMRS)

The *R/V Thompson's* hull-mounted EM300 multibeam system was also used on the NeMO'06 cruise. The 135 beam EM300 system operates at a frequency of 30 kilohertz with a maximum 150° swath when the angles are set at 75° per side. Surveys were conducted in the area of Endeavour Ridge, between Endeavour and Axial, passing over the Cobb Segment of the Juan de Fuca Ridge. Additional EM300 bathymetry data was collected during the AUV search, adding data to the north, east and southeast of previous EM300 coverage in 2002, 2003, and 2004.

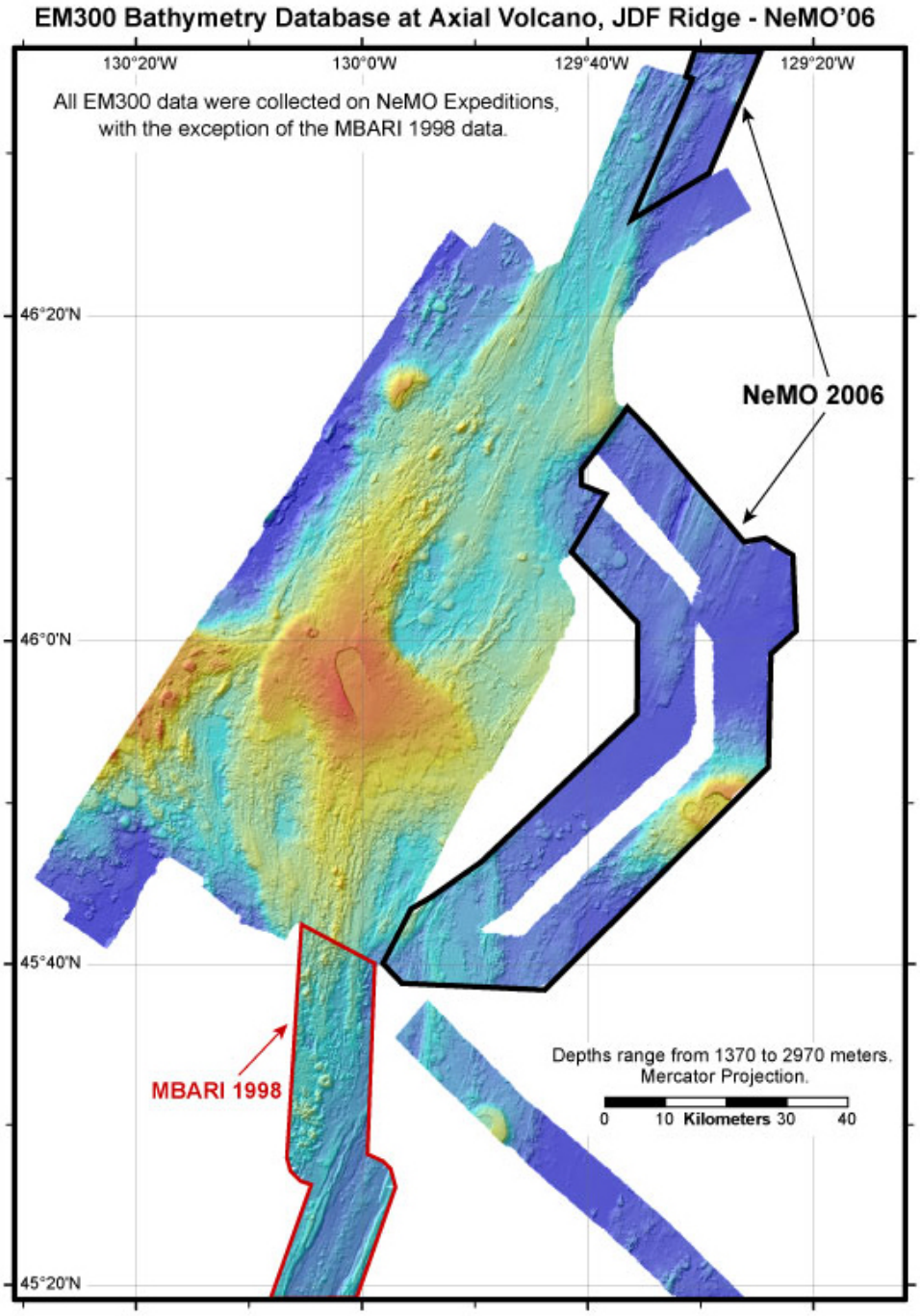

Figure 9

figure 9 back

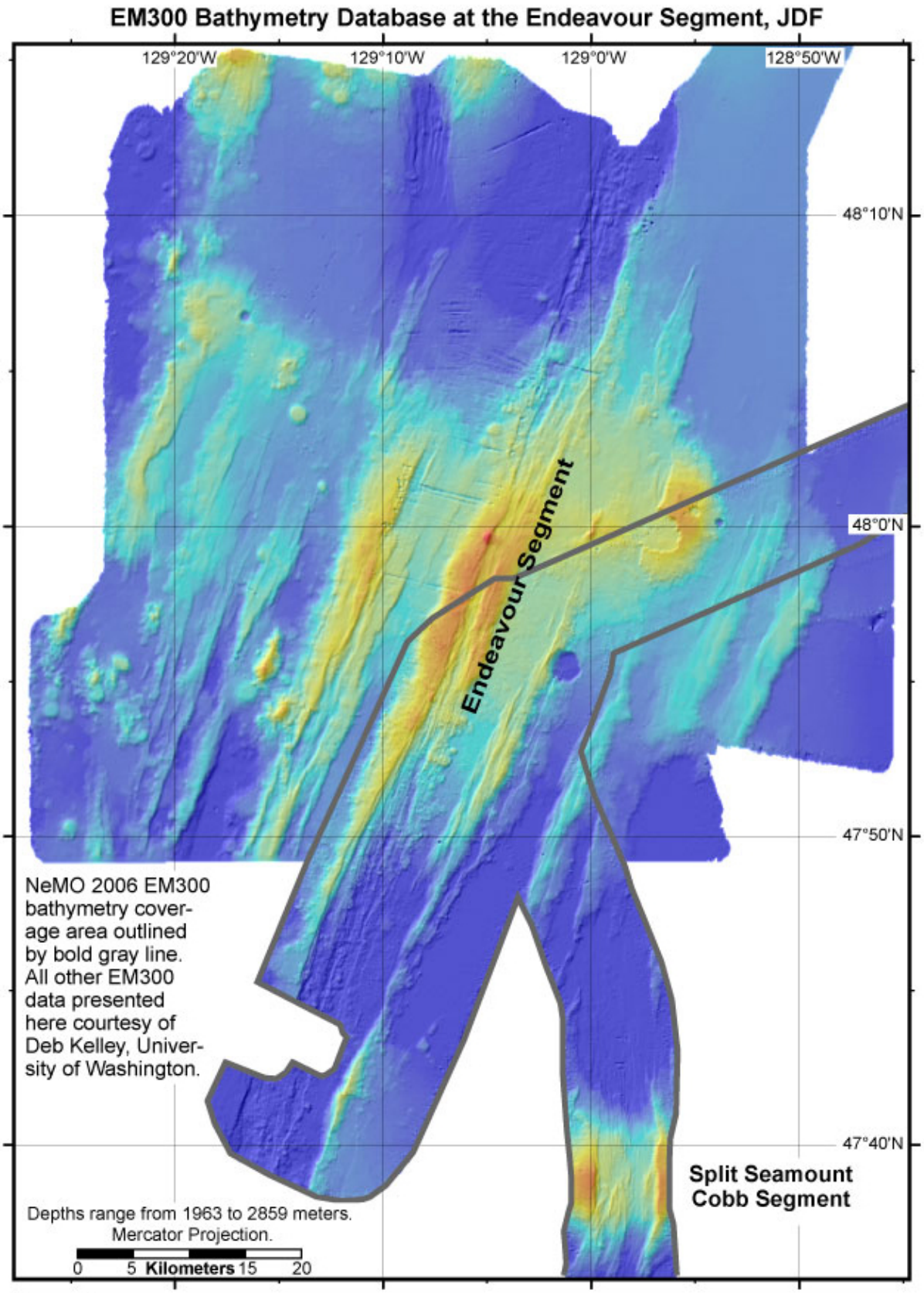
EM300 Bathymetry Database at the Endeavour Segment, JDF
129°20'W
129°10'W
129°0'W
128°50'W
48°10'N
48°0'N
47°50'N
47°40'N
Endeavour Segment
NeMO 2006 EM300 bathymetry coverage area outlined by bold gray line. All other EM300 data presented here courtesy of Deb Kelley, University of Washington.
Split Seamount
Cobb Segment
Depths range from 1963 to 2859 meters.
Mercator Projection.
0 5 Kilometers 15 20

Figure 10

figure 10 back

3.4 HYDROTHERMAL PLUME STUDIES

3.4.1 CTD Operations - NeMO'06

CTD operations for the NeMO'06 cruise consisted of 6 vertical casts (and no tows). Table provided by Geoff Lebon and Sharon Walker. (see Axial map Figure ?)

3.4.1a CTD Casts at Endeavour and Axial, 2006

Cast	Station Name	longitude°	latitude°	Area
1	V06C-01	-129.10910	47.92360	Endeavour - Mothra over Faulty Towers
2	V06C-02	-130.01433	45.93343	ASHES
3	V06C-03	-129.98283	45.99947	NE of caldera
4	V06C-04	-129.99400	45.91700	Coquille
5	V06C-05	-130.02727	45.98880	CASM
6	V06C-06	-129.98006	45.92617	Castle Area

3.5 PUBLIC OUTREACH

3.5.1 NeMO 2006 Website

Andra Bobbitt, Bill Chadwick, Susan Merle (CIMRS)

During the cruise, which lasted 16 days, 9 logs were posted on the NeMO website. Those web logs (and logs from all past NeMO expeditions dating back to 1998) are available for viewing, as well as this and previous cruise reports, on the Vents website at:
http://www.pmel.noaa.gov/vents/nemo/expeditions.html
The website updates from sea were written by Bill Chadwick, with assistance from Susan Merle. The summary was written by Chief Scientist, Dave Butterfield. Andra Bobbitt received the web logs and images on shore, where she compiled and posted the NeMO web pages.

3.6 CHEMISTRY and MICROBIOLOGY

3.6.1 Coordinated Chemical and Microbial Studies

Dave Butterfield,(JISAO/UW/PMEL)

Overview

The NeMO seafloor observatory at Axial Volcano has many aspects and wide-ranging goals, but they all involve scientific measurements to try to understand the spatial variability on the volcano and the temporal evolution of chemical, physical, geological and biological processes. Hydrothermal systems are created by the interaction of seawater with hot ocean crust and they are by nature highly dynamic. By monitoring the temperature and composition of hot springs at different locations, we can make inferences about how conditions are changing beneath the seafloor. Everything is connected, so the geological structure controls how water can pass through the volcano, where it exits at hot springs, and how hot water mixes with cold seawater both below and at the seafloor to generate livable habitat for microbes and hydrothermal vent fauna. A simple example of this connectedness is that nearly all of the known hot springs at Axial are located very close to the caldera ring fault.

The complex connection between microbiological communities and chemical/physical conditions of the hydrothermal habitat is one of the major research themes at NeMO. The team of people working on this problem at NeMO includes Dave Butterfield (UW/PMEL), John Baross (UW), Craig Moyer (Western Washington U.), graduate student Andrew Opatkiewicz (UW), technician Sheryl Bolton (U.Vic.), and post-doc Julie Huber (Marine Biological Lab, Woods Hole). One of the tools we use is a specialized sampling instrument (Hydrothermal Fluid and Particle Sampler, commonly referred to as “the beast”) developed at PMEL that pumps hydrothermal fluid through a manifold while measuring temperature, and directs the fluid into sample containers or through filters to concentrate microbes. Gas-tight samplers are mounted on top of HFPS and connected to the main intake line. We thereby get coordinated chemical/microbiological information about different vent sites around the volcano. We have been doing this kind of sampling as a time-series at specific vent sites, but also in exploration mode, where we locate vents all around the volcano and characterize their chemistry and microbiological communities. So far we have found abundant evidence for microbial activity and low-temperature reactions occurring in the sub-seafloor mixing zone. There are distinct populations of microbes that live in different vent habitats and microbial communities at specific vents have changed over time following the 1998 volcanic eruption at Axial. We are currently trying new statistical approaches to looking at combined microbiological and chemical data to understand the ecology of this volcano.

3.6.1 Summary of 2006 Chemistry Work

For 2006, we were set up to do the normal suite of chemical analyses on board, including pH, alkalinity, dissolved silica, hydrogen sulfide, ammonia, and methane. Marv Lilley could not send anyone on this cruise because of an overlapping Alvin cruise, but we were able to borrow his suitcase gas chromatograph for methane analysis. Geoff Lebon handled the gas analysis of vent fluids and plume samples. Nathan Buck and Andrew Opatkiewicz handled the other chemical analysis, as well as the RAS and HFPS, with assistance from Pamela Maynard and Francoise Labonte. Sheryl Bolton took care of large-volume filters. Leigh Evans handled all gas-tight sampling operations.

Our research this year includes both the Endeavour and Axial sites. At Endeavour, we have been conducting time series sampling, primarily for chemistry, but also including preserved DNA sampling. This work has been funded over the period from 2001 to 2006 by the W.M. Keck Foundation, and involves several investigators at the University of Washington. Our goals for this year were to recover a RAS mooring from the Mothra field and a RAS/PPS combined mooring from the SW Hulk vent site in MEF. Both of the recoveries went well, except that

the temperature recorder (MTR) attached to the instrument at Hulk was stripped off en route to the surface and was not found.

During short dive 1008, we recovered the RAS (number 16) from the Mothra field, located on the east side of the steep flank of The Tower, a chimney making up part of the Faulty Towers complex. Sonardyne Homer number 25 was on this RAS and made it easy to locate. The intake was situated on sulfide in a diffuse flow vent in a depression near the base of the structure. Based on shipboard and post-cruise analysis, the temperature and chemical records agree quite well, showing a warming in the first half of the deployment, peaking in January, 2006, and then declining to near ambient seawater temperature and composition in the last 3 months of the deployment. The trends are consistent in everything we have measured so far. We had time for only minimal sampling after recovering the mooring, but we were able to take an endpoint sample from the warmest point near the RAS 16 intake. A second sample in lower temperature water failed. We also took a sample from a vent that corresponded to the location of "Notre Dame" in the Crab Basin area, where we ended up after the ship maneuvered to recover the mooring. We collected a 1.3 liter filter sample for DNA analysis from Hot Harold (~20m north of Faulty Towers, on the separate "Twin Peaks" structure).

During dive 1009 at the MEF, we launched a RAS mooring east of Hulk (with Homer number 15 attached) and moved in to recover RAS 17 at SW Hulk (with Homer 16 attached). We took several samples at the RAS site using HFS, installed the new RAS with a vent cover and MTR #3005, and took a sample from the vent cover (temperature 32°C). Additional samples were taken at a high-temperature vent on top of Dudley (where the T1 temperature probe developed a pinhole leak in the tip and became unreliable), at a diffuse vent and a smoker at S&M vent, and at a diffuse vent at Easter Island. The fluid sampler was filled during the dive, but not all samples filled properly, with the net result that we collected just enough samples to characterize each site. We collected 1-2 liter DNA samples from the RAS site at SW Hulk, Easter Island, S&M basalt-hosted diffuse flow, and the SE side base of Dudley structure.

At Axial Volcano, we used the fluid sampler on dives 1011, 1013, and 1014, and sampled a range of vents on or near the 1998 lava flow, at ASHES, and in the Castle/El Guapo area, which was named the "International District" vent field. At the very north end of the lava flow, near the dead Magnesia vent, we sampled a vent not seen in previous years, dubbed "Forum". We measured temperatures over 90°C in a very small white chimney with some apparent sulfide minerals in it. We sampled next in the marker N3 area, where we deployed a new marker 52, at what we believe is the same vent that we sampled in 2004. We sampled marker 33 vent and deployed a RAS there, with the PVC cover over the most vigorous part of the flow, and MTR #3043. We put marker 55 where the disappeared marker 33 was. A new area of diffuse flow was found on dive 1012 at 1522m depth 129 58.894 W 45 56.233 N, but no sampling equipment was on board. In the ASHES vent field, we sampled Gollum, Mushroom, Inferno, Hell, and Virgin Mound. On the final dive 1014, we sampled Vixen diffuse vent, Casper high-T, marker 113, Bag City, and boiling vents at the top of El Guapo chimney. The maximum temperature measured at El Guapo was 338.7, which is approximately 9 degrees C below the predicted boiling temperature, but the 2-phase appearance of the fluids indicates that they were actively boiling. One of the goals for the cruise was to use HFS to sample several vents in the CASM area, but due to the loss of one dive day for the AUV search, we cancelled the dive to CASM and will try again in 2007. Overall, we collected 44 vent fluid samples with HFPS in 2006. We collected coordinated 1-2 liter DNA filter samples from background seawater, Forum, marker 33/55, Crack, Marshmallow, Coquille/Vixen, Bag City, and marker 113. We also collected approximately 20-liter DNA samples from marker N3/52, marker 33/55, and Gollum. It was later noted that the high-volume filter at marker N3/52 had metal sulfide minerals in it, which could only have come from the Forum site sampled immediately prior. Because the flush rate with the large McLane pumps is almost 10 times higher than our normal flush rate, heavy particles that accumulate in the low spots of the manifold were apparently dislodged and taken into the filter sample. No evidence of this was seen on any of our other filters (i.e. the cross-contamination was due to the very high flow rate). This is an issue that we will address in the re-build of HFPS. Unfiltered water samples were used for microbial culture work and preserved for cell counts. Although we did not get a filter sample from Cloud vent, and we were unable to dive at CASM, we collected all of the other high-

priority microbial time-series samples at Axial. This is an important step in the continuing microbial observatory work.

The following table gives details of HFPS sample locations and temperatures.

3.6.1a NeMO 2006 HFPS Water Sample Log

Total of 44 successful vent fluid samples.
All filters used are gttp 0.2 micron. All bio filters are Sterivex.
Types: f-filter, b-bag, bf-filtered bag, p-piston, pf-filtered piston, fs-sterivex dna filter.

Sample#	type	location	Z	long deg min W	lat deg min N	date	start time (PDT)	stop time (PDT)	Tmax	T1 avg	vol
		Endeavour									
R1008BF7	BF	Notre Dame	2282	129 6.548	47 55.333	25-Aug-06	21:28:02	21:32:22	30.4	20.8	557
R1008BF9	BF	Faulty Towers	2282	129 6.511	47 55.444	25-Aug-06	22:08:26	22:12:26	62.2	58.9	530
R1009P3	P	Easter Island	2204	129 5.964	47 56.9070	27-Aug-06	00:31:28	00:35:17	25.2	21.8	335
R1009BF7	BF	SW Hulk - crack periphery	2210	129 5.7462	47 57.018	27-Aug-06	17:06:22	17:11:39	25.1	21.9	643
R1009B12	B	SW Hulk - crack periphery	2210	129 5.8122	47 57.025	27-Aug-06	17:17:42	17:22:11	26.2	17.9	100
R1009BF8	BF	SW Hulk - 2006 RAS intake	2210	129 5.8002	47 57.0198	27-Aug-06	18:32:19	18:38:09	32	28.9	565
R1009B13	B	SW Hulk - 2006 RAS intake	2210	129 5.8002	47 57.0198	27-Aug-06	18:39:15	18:43:12	32.8	31.7	65
R1009P1	P	SW Hulk - small black smoker	2209	129 5.8164	47 57.021	27-Aug-06	19:10:11	19:12:46	298.3	295.8	195
R1009BF9	BF	SW Hulk - small black smoker	2209	129 5.8002	47 57.0198	27-Aug-06	19:14:20	19:16:24	295.8	290.6	52
R1009BF10	BF	Dudley SE side hdg 288	2207	129 5.8224	47 56.9682	27-Aug-06	20:38:44	20:42:47	17	15.6	0
R1009P4	P	piston SE side Dudley	2207	129 5.8506	47 56.967	27-Aug-06	20:45:41	20:50:42	15.5	14.3	392
R1009B14	B	bag, Dudley	2198	129 5.8560	47 56.9628	27-Aug-06	21:33:43	21:37:00	300?	276.2	495
R1009P2	P	Dudley top smoker T1 fried	2198	129 5.8566	47 56.9622	27-Aug-06	21:40:44	21:44:39	300?		252
R1009BF11	BF	S&M diffuse vent	2201	129 5.9058	47 56.9082	27-Aug-06	23:10:34	23:15:24	27.7	20.1	517
R1009P5	P	S&M smoker hdg 302	2189	129 5.8922	47 56.9064	27-Aug-06	23:47:44	23:50:29	285.7	280.7	195

Sample#	type	location	Z	long deg min W	lat deg min N	date	start time (PDT)	stop time (PDT)	Tmax	T1 avg	vol
		Axial Volcano									
R1011BF7	BF	Forum, down in collapse near base of pillars	1529	129 59.005	45 56.797	1-Sep-06	10:08:02	10:11:47	91.2	74.4	500
R1011P1	P	Forum tubeworm bush	1529	129 59.005	45 56.797	1-Sep-06	10:14:13	10:19:18	83.7	80.5	304
R1001BF8	BF	Mkr N3/52 white rock face same as 2004	1530	129 59.110	45 56.618	1-Sep-06	11:36:16	11:39:48	24.3	23.2	643
R1011P2	P	Mkr N3/52 white rock face same as 2004	1530	129 59.110	45 56.618	1-Sep-06	11:41:15	11:47:05	24.7	24.4	322
R1011B13	B	MkrN3/52 white rock face	1530	129 59.110	45 56.618	1-Sep-06	11:49:35	11:53:06	24.6	24.3	?
R1011BF9	BF	Mkr 33, failed	1524	129 58.937	45 55.993	1-Sep-06	15:23:13	15:26:33	19.2	18.6	0
R1011BF10	BF	Mkr 33	1524	129 58.937	45 55.993	1-Sep-06	15:27:39	15:31:42	18.9	18.3	317
R1011P3	P	Mkr 33	1524	129 58.937	45 55.993	1-Sep-06	15:33:52	15:38:24	18.5	18.0	250
R1013P1	P	Gollum	1546	130 0.797	45 56.015	3-Sep-06	10:45:42	10:48:11	20.4	15.2	0
R1013B12	B	Gollum	1546	130 0.797	45 56.015	3-Sep-06	10:49:46	10:53:39	32.2	29.3	627
R1013PF5	p	Gollum	1546	130 0.797	45 56.015	3-Sep-06	10:55:36	11:02:33	29.5	26.0	595
R1013P2	P	Mushroom	1547	130 0.815	45 56.017	3-Sep-06	11:48:02	11:53:08	80.5	58.3	375
R1013BF7	BF	Mushroom	1547	130 0.815	45 56.017	3-Sep-06	11:54:36	12:00:25	62.3	55.8	595
R1013BF8	BF	Inferno, top beehive	1544	130 0.818	45 56.014	3-Sep-06	12:49:51	12:52:55	284.0	278.8	503
R1013P3	P	Inferno, top beehive	1544	130 0.818	45 56.014	3-Sep-06	12:56:13	13:00:14	274.1	268.8	480
R1013B13	B	Inferno, top beehive	1544	130 0.818	45 56.014	3-Sep-06	13:08:28	13:11:18	260.5	249.6	475
R1013B14	B	Inferno, top, failed	1544	130 0.818	45 56.014	3-Sep-06	13:18:31	13:21:48	300.9	295.4	0
R1013BF11	BF	Hell	1543	130 0.835	45 55.999	3-Sep-06	13:49:39	13:53:42	127.2	111.9	548
R1013P4	p	Hell	1543	130 0.835	45 55.999	3-Sep-06	13:57:45	14:03:08	105.2	93.3	740

Sample#	type	location	Z	long deg min W	lat deg min N	date	start time (PDT)	stop time (PDT)	Tmax	T1 avg	vol
R1013PF6	p	VM	1546	130 0.788	45 56.022	3-Sep-06	14:30:53	14:33:47	244.8	234.9	220
R1013BF9	BF	VM	1546	130 0.788	45 56.022	3-Sep-06	14:37:18	14:39:04	248.7	244.7	215
R1013BF10	BF	VM	1546	130 0.788	45 56.022	3-Sep-06	14:40:19	14:43:27	252.3	248.3	342
R1014P2	P	Vixen diffuse	1538	129 59.579	45 55.034	4-Sep-06	09:56:20	10:00:38	29.5	28.4	815
R1014BF7	BF	Vixen diffuse, hdg 188	1538	129 59.579	45 55.034	4-Sep-06	10:02:22	10:06:10	29.7	28.5	619
R1014P3	P	Casper	1538	129 59.578	45 55.049	4-Sep-06	10:39:03	10:43:26	290.4	289.9	785
R1014BF9	BF	Casper	1538	129 59.578	45 55.049	4-Sep-06	10:45:28	10:47:22	291.4	290.8	314
R1014B12	B	Bag City	1536	129 59.35	45 54.979	4-Sep-06	12:32:55	12:36:32	15.1	14.7	614
R1014BF8	BF	Bag City	1536	129 59.35	45 54.979	4-Sep-06	12:37:49	12:41:36	15.2	14.7	639
R1014BF10	BF	Mkr 113	1524	129 59.306	45 55.364	4-Sep-06	14:34:11	14:38:05	28.7	28.2	636
R1014B14	B	Mkr 113	1524	129 59.306	45 55.364	4-Sep-06	14:40:37	14:44:19	28.5	28.3	674
R1014BF11	BF	El Guapo	1509	129 58.795	45 55.597	4-Sep-06	16:35:28	16:37:32	298.6	285.0	359
R1014B13	B	El Guapo	1509	129 58.795	45 55.597	4-Sep-06	16:37:57	16:40:00	313.3	307.4	376
R1014PF6	PF	El Guapo	1509	129 58.795	45 55.597	4-Sep-06	16:41:31	16:45:18	336.5	319.2	655
R1014PF5	PF	El Guapo	1509	129 58.795	45 55.597	4-Sep-06	16:48:27	16:51:59	338.7	337.6	555

3.6.2 Hydrothermal Fluid Microbiology

Sheryl Bolton (UVic/UW), Andrew Opatkiewicz (UW) and Pamela Maynard (UW)

Nine years after the most recent eruption of Axial Seamount our time-series study of the microbial community continued with resampling of diffuse fluids at several key vents, as well as some that were newly discovered, using Dave Butterfield's Hot Fluid and Particle Sampler. In addition to continuing semi-quantitative culture enrichments (MPNs, Most-Probable Number technique) from long term time-series vents, fluids were also inoculated into media that select for specific metabolic types (e.g. sulfate and iron reduction). Fluids were fixed for whole cell counts and filters were collected for DNA analysis at time-series vents as well.

Fluids collected from four time-series vents (Markers 33 and 113, Bag City and Gollum) as well as one first sampled in 2004 (Marker 52) and the newly discovered Forum Vent were used for thermophilic and hyperthermophilic culture enrichments. Results of semi-quantitative culturing (MPNs) are shown in the table below. Numbers of heterotrophs at Bag City increased this year by enriching for themophiles rather than hyperthermophiles which correlates with the steadily decreasing temperature of the vent. In contrast, other vents such as Gollum and Marker 113 continue to have decreasing numbers of hyperthermophilic heterotrophs and autotrophs even though the temperatures of those vents have remained fairly steady throughout the time-series.

Results of Most Probable Number Technique

Location	Sample T (C)	Culture T (C)	Microbe Type	Microbes/L
Forum	84	90	Hyperthermophilic heterotroph	140-4200
Marker 52	25	90	Hyperthermophilic heterotroph	<60
Marker 33	18	90	Hyperthermophilic heterotroph	<60
		90	Hyperthermophilic autotroph	<60
Gollum	32	90	Hyperthermophilic heterotroph	20-720
		90	Hyperthermophilic autotroph	<60
Bag City	15	70	Thermophilic heterotroph	80-2400
		70	Thermophilic autotroph	10-400
Marker 113	28	90	Hyperthermophilic heterotroph (no S)	80-2400

Two types of DNA filters were collected this year. The first type (Sterivex), through which we filtered 2-3 liters of hydrothermal fluids using the Hot Fluid and Particle Sampler, will be used to continue an ongoing temporal and spatial study of several key vents using the molecular fingerprinting technique Terminal Restriction Fragment Length Polymorphism (T-RFLP). This method provides basic microbial community structure information that can be compared with changing chemical and environmental conditions within and between vents. The second filter type (Steripak) is designed to filter higher volumes. Up to 20 liters per filter were sampled from three vents (Marker 33, Marker 52 and Gollum) using two McLane pumps mounted on ROPOS. These filters will be used by Julie Huber (Marine Biological Laboratory) to continue a recently published "rare biosphere" metagenomics study that included samples from Axial (Sogin et al. PNAS 2006).

This year's cruise also included 2 dives at the Endeavour segment during which we recovered 2 year-long RAS moorings from Hot Harold (Mothra Field, RAS only) and Hulk (Main Field, RAS and PPS). Fluid and DNA samples were also collected in several locations at Hulk for a microenvironment diversity study.

3.6.2a 2006 Microbiology Sample List and Analysis Overview

Dive #	Log Sample #	Sample Type	Description	Culture	DNA	Cell Counts
ENDEAVOUR						
R1008	R1008_HFS-0005	Sterivex filter #15	Hot Harold diffuse (Tmax=76.4 C)		X	
R1009	R1009-HFS-0003	Bag #12	SW Hulf crack periphery diffuse (Tmax=28.9 C)	X		X
R1009	R1009-HFS-0004	Sterivex filter #15	SW Hulk crack periphery diffuse (Tmax=28.9 C)		X	
R1009	R1009-HFS-0006	Bag #13	SW Hulk 2006 RAS intake (Tmax=32.8 C)	X		X
R1009	R1009-HFS-0007	Sterivex filter #16	SW Hulk 2006 RAS intake (Tmax=32.8 C)		X	
R1009	R1009-HFS-0011	Bag #10	SE side of Dudley diffuse (Tmax=16.7 C)	X		X
R1009	R1009-HFS-0013	Sterivex filter #24	SE side of Dudley diffuse (Tmax=16.7 C)		X	
R1009	R1009-HFS-0018	Sterivex filter #23	S&M basalt-hosted diffuse (Tmax=30.4 C)		X	
R1009	R1009-HFS-0021	Piston #3	Easter Island diffuse (Tmax=unknown)	X		X
R1009	R1009-HFS-0022	Sterivex filter #22	Easter Island diffuse (Tmax=unknown)		X	
AXIAL						
R1011	R1011-HFS-0001	Sterivex filter #24	Bottom background water		X	
R1011	R1011-HFS-0004	Piston # 1	Forum, '98 flow (Tmax=83.7 C)	X		X
R1011	R1011-HFS-0005	Sterivex filter #23	Forum, '98 flow (Tmax=92.6 C)		X	
R1011	R1011-HFS-0008	Piston # 2	Marker 52, '98 flow (Tmax=24.7 C)	X		X
R1011	R1011-McLane-0009	Steripak filter	Starboard high volume filter at Marker 52, '98 flow (Tmax=24.7 C)		X	
R1011	R1011-HFS-0017	Piston # 3	Marker 33, '98 flow (Tmax=18.5 C)	X		X
R1011	R1011-McLane-0019	Steripak filter	Port high volume filter at Marker 33, '98 flow (Tmax=18 C)		X	
R1013	R1013-McLane-0001	Steripak filter	Starboard high volume filter at Gollum, ASHES (Tmax=20 C)		X	
R1013	R1013-HFS-0003	Bag #12	Gollum, ASHES (Tmax=32.2 C)	X		X
R1013	R1013-HFS-0005	Sterivex filter #18	Gollum, ASHES (Tmax=29.8 C)		X	
R1013	R1013-HFS-0006	Piston #2	Mushroom, ASHES (Tmax=80.5 C)	X		X
R1013	R1013-HFS-0012	Piston #3	Inferno, ASHES (Tmax=274 C)			X
R1013	R1013-HFS-0014	Bag #13	Inferno, ASHES (Tmax=260 C)			X
R1013	R1013-HFS-0017	Piston #4	Hell, ASHES (Tmax=105 C)			X
R1013	R1013-HFS-0026	Sterivex filter #22	Crack, ASHES (Tmax=50.6 C)		X	
R1013	R1013-HFS-0027	Sterivex filter #21	Marshmallow, ASHES (Tmax=106.8 C)		X	
R1014	R1014-HFS-0002	Piston #2	Diffuse near Vixen (Tmax=29.5 C)	X		X
R1014	R1014-HFS-0004	Sterivex filter #18	Diffuse near Vixen (Tmax=30.7 C)		X	
R1014	R1014-HFS-0005	Piston #3	Casper (Tmax=290.4 C)			X
R1014	R1014-HFS-0010	Bag #12	Bag City mkr. 36 (Tmax=15.1 C)	X		X
R1014	R1014-HFS-0012	Sterivex filter #15	Bag City mkr. 36 (Tmax=15.5 C)		X	
R1014	R1014-HFS-0016	Bag #14	Marker 113 (Tmax=28.5 C)	X		X
R1014	R1014-HFS-0017	Sterivex filter #20	Marker 113 (Tmax=28.5 C)		X	
R1014	R1014-HFS-0020	Bag #13	El Guapo, International District (Tmax=313.4 C)			X

3.6.3 Sampling for Helium Isotope Analysis:
Leigh Evans (CIMRS)

A variety of vents were sampled. Twelve actuations of gastight bottles were successful in obtaining samples. Most were of high quality including those from Inferno, El Guapo and Magnesia. Along with some others that could be slightly compromised, they will add to time series that extendg back to 1995. In some cases the comparisons of samples will be only geographic and will need other data to elucidate the condition of the volcano.

3.6.3a Helium Samples and Gas Concentrations

Dive	date	Bottle#	Vent	Area	reported T (°C)	sample wt (grams)	gas (mmol/kg)
R1009	27-Aug	GT 15	Top Dudley	Endeavour	> 288	161	18.2
R1009	27-Aug	GT 15	Top Dudley	Endeavour	> 288	161	17.8
R1009	27-Aug	GT 11	Easter Island	Endeavour	14	170	3.5
R1009	27-Aug	GT 5	Hulk	Endeavour	295	142	21.8
R1009	27-Aug	GT 5	Hulk	Endeavour	295	142	21.7
R1011	2-Sep	GT 15	Magnesia	Axial	76	165	28.6
R1011	2-Sep	GT 11	Magnesia	Axial	76	165	28.9
R1011	2-Sep	GT 11	Mkr 33	Axial	17.8	47.6	7.5
R1013	3-Sep	GT 7	V.M.	Axial	248	58.9	194
R1013	3-Sep	GT 2	Inferno	Axial	245	86.4	77.2
R1013	3-Sep	GT 5	Mushroom	Axial	64	150	28.5
R1013	3-Sep	GT 6	Inferno	Axial	270	169	66.5
R1014	4-Sep	GT 7	El Guapo	Axial	312	137	72.0
R1014	4-Sep	GT 11	Caspar	Axial	290	19.5	140
R1014	4-Sep	GT 2	El Guapo	Axial	300	20.3	93.3

4.0 NAVIGATION

4.1 ROPOS Navigation System Overview

Vincent Auger (CSSF navigator)

The ROPOS team is constantly improving its navigation system to provide its clients with increasingly accurate and repeatable sub-sea navigation. With that objective in mind, three navigation sensors were purchased over the past two years: a 1200 KHz RDI Doppler Velocity Log (DVL), an IXSEA OCTANS III fibre optic gyrocompass (FOG), and an IXSEA GAPS USBL acoustic navigation system. This USBL system is unique because the transducer head contains its own sensors and offsets and so is "self-calibrating".

Initially, the DVL was used to produce a relative displacement of the vehicle from a "seeding" point determined with the USBL system. There were however inherent problems with this method and the benefits of blending all three sensors together to generate one geodetic position were quickly apparent. To achieve this, the Kalman filter method was chosen. By blending all sensors according to a vehicle model and each sensor's accuracy over time, this filter can provide the best position estimate possible taking into account all available sensors.

Over the last winter, CSSF designed a Kalman filter named LOKI. LOKI is a java based multi-threaded program that handles all sensors input in real-time and generates a best state estimate using well established frame translations and Kalman filter algorithms. While we are very pleased with the results seen with the LOKI system and our current navigation system, it is still in its infancy and we will evaluate the data accumulated from the 2006 operational season in order to further improve on its potential.

4.2 Navigation Summary: At Sea and Postcruise

Susan Merle (CIMRS)

The new ROPOS system produces navigation that is more continuous and has fewer outliers than the LBL transponder navigation that has been used on previous NeMO cruises and was hampered by the noise of the ROPOS hydraulic motors. However the new system had its own problems on this cruise. One problem was the responder on the vehicle did not work consistently. Consequently at times there were long periods between USBL fixes which cause the doppler to wander (noticeable when the vehicle was sitting in one place for an extended period, for example). The doppler wander was removed from the navigation files when obvious (when the ROV was known to be stationary). However, this doppler wander is impossible to correct when the ROV was moving. Another issue is that the 2006 vent positions are offset from positions in previous years. Both positions in 2006 and 2003 are listed in the tables below (Tables 4.2a and 4.2b).

The other major navigation problem was that the USBL transducer head became "uncalibrated" at the beginning of the cruise (due to a firmware fault that reset all the internal offsets to zero). As Vinnie's document states (above section 4.1) the 2006 ROPOS LOKI navigation output merges the USBL (Ultra-Short BaseLine), FOG and Doppler sensors. Correspondence post-cruise with Vinnie about the nav quality during the NeMO 2006 cruise states that on the dives prior to Sept 1st, there is up to 50 meters or more error in the navigation. The problem was discovered on dive R1010 (the pressure sensor dive) when the navigation was offset each time the ROV returned to the same benchmarks visited previously on the dive. Also, when the ROV was stationary on the bottom its position would wander if the ship's heading changed. This head calibration problem was corrected on August 31st at 6:30 PM PST. All the MBARI mapping AUV dives were conducted after this problem was corrected (only the first AUV dive that veered off course took place before this date, but no useful mapping data were collected). However, there are still offsets of up to 50 meters (from doppler wander?) between the AUV nav in the International district and ROPOS positions (see Figure 17). Also note that the preliminary AUV

bathymetry depths were not corrected for latitude or tides and are shallower than the Imagenex data by 5-7 meters.

4.2a ROPOS and AUV Dive Dates and Position Information for Each Dive

Aug 25-26. Nav error > 50m
R1008 Mothra Field, Endeavour Segment
ROPOS navigation is offset to the N/NE 35 - 65m.
Actual Endeavour vent positions are based on Deb Glickson's 2005 vent position list at Endeavour (taken from the Ridge 2000 web site).
Notre Dave area:
The navigation is offset ~65m to the N of Glickson's position.
Hot Harold area:
The navigation is offset ~35m to the N/NE of Glickson's position.

Aug 26. Nav error > 50m
R1009 Main Endeavour Field. Deploy RAS and fluid sample
ROPOS navigation is offset to the N/NE 30 - 60m.
Actual Endeavour vent positions are based on Deb Glickson's 2005 vent position list at Endeavour (taken from the Ridge 2000 web site).
SW Hulk area:
The navigation is offset ~30m to the N/NE of Glickson's position.
Dudley area:
The navigation is offset 50-60m to the N of Glickson's position.
S&M area:
The navigation is offset ~60m to the N/NE of Glickson's position
Easter Island area:
The navigation is offset ~50m to the N/NE of Glickson's position.

Aug 27-28. Nav error >50m
AUV dive. NE of caldera. Axial.
Turned into search for the AUV. Very little data collected.

Aug 29-31. Nav error >50m
R1010 Pressure dive. Caldera center to S Pillow Mound (3 traverses). Axial.
This is the dive when the navigation problem was discovered.
An updated sample list was created with that has revised (guesstimate) positions for the samples which are more accurate.
Caldera Center:
Navigation put the position in nearly the same place for all traverses (scatter was ~25m) Placed the benchmark >30m N/NW of the probable position.
Magnesia area:
Visits to the benchmark put the navigation both west and east of the 2003 position (~100m scatter). All visits to Magnesia benchmark put the navigation to the west of the position on following dive (R1011)
Mkr-33:
2006 nav as NW of of position on next dive (R1011).
Visits on this dive put the nav 20-50m NW of benchmark position. Nav scatter was ~35+.
Cloud area:
~35m due north of position on next dive (R1011), > 20m north of '03 position.
Bag City area:
On first approach set down >500m east of the vent, thinking we were there. Took more than 45 minutes to get to the benchmark site. The position on the first traverse is >30m NW of '03 benchmark position, ~40m NW of the '06 Bag City Vent position.
On the second pressure reading the position is ~30m north of the '03 benchmark position, and about 30m NE of the position on the previous pressure reading. The last visit put us >30m due W of the '03 benchmark position, almost 50m west of the '06 Bag City Vent position. Nav scatter at the benchmarks on the 3 visits is > 50m.
South Pillow Mound
First traverse the nav put the benchmark >30m NW of the probable position. On the second traverse the nav put the benchmark > 30m N/NE of the probable position. The 2 positions are ~50m apart.

Aug 31-Sept 1. Nav should be correct but AUV and ROPOS nav do not agree in area of International District (See Figure 17)
AUV dive. 1998 lava flow area. Axial.
(20060901_AUV_Survey.DAT data file. 20060901_AUV_Survey1.DAT data file was empty)
Looks like most of the vent sites on the east side were mapped on that first major AUV survey The data in the area of the big sulfides was collected on this dive. See ROPOS dive R1014 position information below.

Sept 1. Performed another nav test on this dive. Nav OK?
R1011 Northern 98 flow down to Mkr-33 area. Axial.
Sample positions are final and agree with the navigation. Nav seems to agree well with the collapse areas and fissures up north. Where we have known vent positions there was an offset between the ROPOS 2006 navigation (Loki nav) and 2003/2004 positions (transponder nav).
Magnesia'06 60m E/NE of '03 position
Mkr-N3'06 is ~20m S/SE of '03 position
The R1011 rumbleometer position is ~10mE of the R1012 position (when it was recovered) - so the 2006 positions varied as well.

Mkr-33'06 position is ~3m W of '03 position
Cloud Mkr69 (the pit) ~12m S of '03 position

Sept 1-2. Nav OK?
AUV dive. E/NE of caldera rim. Axial.
(AUV2 ,2a, 2b data files - AUV2c file was empty)

Sept 2. Nav OK?
R1012 1998 lava flow pillar dive and rumbleometer recovery. Axial.
Sample positions are final and agree with the navigation. The only time we came near a known vent position on this dive is when we went north of benchmark-5 (NW of Mkr-33 Vent) looking for Verena's wood. Found the wood 35m N of the benchmark, and the log states that position as about 40m north of the benchmark, so the nav seems to be accurate, also agreeing with the collapse features, etc….

Sept 2-3. Nav OK?
AUV dive. Southern area of the 1998 lava flow, southern caldera, ASHES. Axial.
(AUV3, 3a data files)

Sept 3. Nav OK?
R1013 ASHES. Axial.
Sample positions are final and agree with the navigation.
Where we have known vent positions there was an offset between the ROPOS 2006 navigation (Loki) and 2003/2004 positions (transponder). At ASHES 2006 vent site positions were E/SE of the 2003 positions.
Virgin'06 28m E of '03 position.
Inferno'06 20+m E of '03 position.
Gollum'06 23m E of '03 position.
Phoenix'06 28m E of '03 position.

Sept 3-4. Nav OK?
AUV dive. North N Rift Zone with tieline down the E side of the caldera rim thru 98 flow to Vixen. Axial.
(Auv4 data file)

Sept 4. Nav OK?
R1014 Southern '98 flow and old flow, International district (new sulfides). Axial.
Sample positions are final and agree with the navigation.
Where we have known vent positions there was an offset between the ROPOS 2006 navigation (Loki) and 2003/2004 positions (transponder).
Coquille Vent Field: '06 positions were about 10 meters N or '03 positions.
eg. Casper: ROPOS Z=1537.5, Imagenex Z=1538, AUV Z=1530
Coquille to Bag City: While traversing the collapse and lava pillar area the nav seemed to agree well with the AUV bathy (collapse and sheet flow positions etc.)
Bag City Vent Field: '06 positions are ~15m NE of '03 positions.
Depths: ROPOS 1536, Imagenex 1536, AUV 1530
Bag City to Mkr-113: Nav agreed well with the AUV data when going over collapses, etc.
Mkr-113 Area: '06 position is 15 m NW of '03 position
Mkr-113 to Castle: Nav seems to agree with the AUV data when going over collapses, etc.
Castle Area: At 2240 we were at Castle Chimney. Good nav snail trail but it doesn't agree with the bathymetry. The ROPOS navigation is putting us about 50 meters west of the big sulfide structures that we see on the AUV data, just like at sea. On this last ROPOS dive we were passing over data collected on different AUV surveys, which is probably the reason that the nav and AUV data match up to the southwest, but not in the area of the big sulfide chimneys. It appears that most of the vent sites on the 1998 lava flow were mapped during that first major AUV survey, before the ROPOS nav calibration error was discovered (nav files in 20060901 directory).

Sept 4-5. Nav OK?
AUV dive. Tie line from Castle area to Mkr-113 and north to NE caldera floor. Axial.
(Auv5, 5a data files)

4.3 POSITION TABLES FOR VENTS, INSTRUMENTS, AND TRANSPONDERS

4.3.1 Vent Positions at Axial, NeMO 2006 (USBL/LOKI navigation)

Only vents visited in 2006 included in this table.

Vent	longitude (dec°W)	latitude (dec°N)	long°	long min	lat °	lat min	Z (m)
Bag City	-129.989241	45.916242	-129	59.35446	45	54.97452	1536
Casper	-129.992956	45.917481	-129	59.57736	45	55.04886	1538
Castle'06	-129.980382	45.926175	-129	58.82292	45	55.57050	1518
Flattop'06 (Mkr-N5)	-129.980135	45.926152	-129	58.80810	45	55.56912	1522
CloudPit (Mkr-69)	-129.981612	45.933295	-129	58.89672	45	55.99770	1525
Crack-flowmeter	-130.013336	45.933305	-130	0.80016	45	55.99830	1546
Diffuse-Village	-129.980597	45.926118	-129	58.83580	45	55.56710	1520
Diva'06	-129.979601	45.926452	-129	58.77606	45	55.58712	1524
Droopy Pillar	-129.984352	45.929867	-129	59.06110	45	55.79200	1522
ElGuapo'06	-129.979914	45.926587	-129	58.79484	45	55.59522	1507
elephant trunk	-129.986167	45.946648	-129	59.17000	45	56.79890	
Escargot	-129.979737	45.926468	-129	58.78422	45	55.58808	1520
Fissure NNW	-129.984402	45.940940	-129	59.06410	45	56.45640	
ghost train wheel	-129.984065	45.932082	-129	59.04390	45	55.92490	1519
Gollum	-130.013289	45.933567	-130	0.79734	45	56.01402	1547
Grand Canyon	-129.988932	45.918003	-129	59.33590	45	55.08018	1539
Hell	-130.013906	45.933317	-130	0.83436	45	55.99902	1550
Hermosa	-129.979849	45.926547	-129	58.79094	45	55.59282	1519
Inferno	-130.013640	45.933560	-130	0.81840	45	56.01360	1547
little-diffuse-vents	-129.983589	45.946127	-129	59.01534	45	56.76762	1519
Magnesia [Mkr-67]	-129.984238	45.946464	-129	59.05428	45	56.78784	1526
Mkr-D	-130.013637	45.933300	-130	0.81822	45	55.99800	1546
Marshmallow-Mkr-I	-130.013286	45.933638	-130	0.79716	45	56.01828	1546
Mkr-36 (Bag City)	-129.989233	45.916250	-129	59.35400	45	54.97500	1534
Mkr-113	-129.988396	45.922804	-129	59.30376	45	55.36824	1526
Mkr-21 (Bag City)	-129.989237	45.916220	-129	59.35420	45	54.97320	1535
Mkr-33 Vent	-129.982232	45.933193	-129	58.93392	45	55.99158	1524
Mkk55 (near Mkr-33)	-129.982303	45.933172	-129	58.93820	45	55.99030	1524
Mkr-N3 Vent(Mkr-52)	-129.985181	45.943639	-129	59.11086	45	56.61834	1530
Mushroom	-130.013580	45.933625	-130	0.81480	45	56.01750	1547
ChemoClams	-129.983046	45.933477	-129	58.98276	45	56.00862	1524
NewVenting	-129.988478	45.921927	-129	59.30870	45	55.31560	1524
Phoenix	-130.013624	45.933278	-130	0.81744	45	55.99668	1547
pillar samp site	-129.985122	45.932062	-129	59.10730	45	55.92370	1523
RumbleWeight	-129.984062	45.930150	-129	59.04370	45	55.80900	1524
Styx-Mkr21	-130.013586	45.933274	-130	0.81516	45	55.99644	1547
Forum	-129.983979	45.946323	-129	59.03874	45	56.77938	1529
The Spot	-129.992990	45.917240	-129	59.57940	45	55.03440	1537
Top-Gun'06	-129.980004	45.926582	-129	58.80024	45	55.59492	1520
Virgin 2006	-130.013134	45.933695	-130	0.78804	45	56.02170	1546
Vixen	-129.992926	45.917345	-129	59.57556	45	55.04070	1537
wormhat-samp	-130.013658	45.933450	-130	0.81948	45	56.00700	1546

Vent	longitude (dec°W)	latitude (dec°N)	long°	long min	lat °	lat min	Z (m)
Zen Garden	-129.981277	45.937278	-129	58.87660	45	56.23670	1519
9meterchimney'06nav	-129.979659	45.926507	-129	58.77954	45	55.59042	

4.3.2 Vent Positions at Axial, NeMO 2003 (transponder navigation)

Vents visited over many years (2004 and prior) included in this table. T here was no navigation at Axial during NeMO 2004.

Vent	longitude (dec°W)	latitude (dec°N)	long°	long min	lat °	lat min	Z (m)
91Vent	-130.012417	46.038600	-130	0.74502	46	2.31600	1640
Ash-11.0	-129.999088	45.941333	-129	59.94528	45	56.47998	1330
BagCity	-129.989425	45.916167	-129	59.36550	45	54.97002	1537
BlueNose	-129.983700	45.945440	-129	59.02200	45	56.72640	1527
Bob	-130.012833	46.038917	-130	0.76998	46	2.33502	1641
Casper	-129.992977	45.917370	-129	59.57862	45	55.04220	1538
Castle	-129.980057	45.926168	-129	58.80342	45	55.57008	1522
Flattop-Mkr-N	-129.979792	45.926075	-129	58.78752	45	55.56450	1522
Circ	-129.981650	45.925917	-129	58.89900	45	55.55502	1525
Cloud-Mkr-N4	-129.981670	45.933418	-129	58.90020	45	56.00508	1523
Cloud-Mkr-N6/21	-129.981600	45.933400	-129	58.89600	45	56.00400	1524
Coquille	-129.993058	45.917530	-129	59.58348	45	55.05180	1537
Crack	-130.013550	45.933300	-130	0.81300	45	55.99800	1547
Crevice	-129.990400	45.911100	-129	59.42400	45	54.66600	1540
Daves	-130.013767	45.933517	-130	0.82602	45	56.01102	1547
Village	-129.980597	45.926118	-129	58.83582	45	55.56708	1520
DroopyPillar	-129.984352	45.929867	-129	59.06112	45	55.79202	1522
Dying	-129.991850	45.916850	-129	59.51100	45	55.01100	1536
Easy	-129.984717	45.945333	-129	59.08302	45	56.71998	1535
FeCity	-129.989190	45.917540	-129	59.35140	45	55.05240	1536
FeHyde	-130.013783	45.932983	-130	0.82698	45	55.97898	1547
Gollum	-130.013583	45.933583	-130	0.81498	45	56.01498	1547
Hairdo	-130.013983	45.933500	-130	0.83898	45	56.01000	1547
Hell	-130.014227	45.933298	-130	0.85362	45	55.99788	1550
Inferno	-130.013900	45.933550	-130	0.83400	45	56.01300	1547
FeSulfide	-129.990738	45.916710	-129	59.44428	45	55.00260	1535
Joystick-Mkr-42	-129.988563	45.918838	-129	59.31378	45	55.13028	1534
Magnesia-Mkr-67	-129.984933	45.946233	-129	59.09598	45	56.77398	1532
Marshmallow	-130.013617	45.933700	-130	0.81702	45	56.02200	1546
Medusa	-130.013933	45.933350	-130	0.83598	45	56.00100	1547
Milky-Mkr-N2	-129.984753	45.945142	-129	59.08518	45	56.70852	1533
Minisnow-Mkr-N9	-129.984217	45.942617	-129	59.05302	45	56.55702	1524
Mkr-33	-129.982200	45.933182	-129	58.93200	45	55.99092	1524
Mkr-108	-129.983033	45.928650	-129	58.98198	45	55.71900	1524
Mkr-113	-129.988238	45.922728	-129	59.29428	45	55.36368	1526
Mkr-33	-129.982197	45.933177	-129	58.93182	45	55.99062	1524
Mkr-36	-129.989333	45.916217	-129	59.35998	45	54.97302	1534
Mkr-65	-129.989628	45.916013	-129	59.37768	45	54.96078	1534

Vent	longitude (dec°W)	latitude (dec°N)	long°	long min	lat °	lat min	Z (m)
Mkr-N1	-129.984083	45.939800	-129	59.04498	45	56.38800	1522
Mkr-N3	-129.985200	45.943800	-129	59.11200	45	56.62800	1529
Mkr-N41	-129.981383	45.936217	-129	58.88298	45	56.17302	1521
Mkr-N44	-129.984833	45.939467	-129	59.08998	45	56.36802	1522
Mkr-N5	-129.979812	45.926097	-129	58.78872	45	55.56582	1515
Mkr-N7	-129.981900	45.939300	-129	58.91400	45	56.35800	1520
Mrk-113	-129.988252	45.922757	-129	59.29512	45	55.36542	1526
Mushroom	-130.013800	45.933600	-130	0.82800	45	56.01600	1547
Nascent [Mkr-M]	-129.981597	45.935840	-129	58.89582	45	56.15040	1520
OldFlow	-129.981705	45.936447	-129	58.90230	45	56.18682	1522
OldWorms	-129.983308	45.945105	-129	58.99848	45	56.70630	1526
Ouzo	-129.984683	45.945817	-129	59.08098	45	56.74902	1529
Oxide	-129.985083	45.945450	-129	59.10498	45	56.72700	1533
Phoenix	-130.013983	45.933250	-130	0.83898	45	55.99500	1547
Pillar	-129.985417	45.922700	-129	59.12502	45	55.36200	1524
PillowMound	-130.003717	45.863150	-130	0.22302	45	51.78900	1723
ROPOS	-130.014050	45.933283	-130	0.84300	45	55.99698	1547
Roof	-129.984483	45.942500	-129	59.06898	45	56.55000	1523
RumbleWeight	-129.984062	45.930150	-129	59.04372	45	55.80900	1524
Snail-Mkr-N8	-129.981900	45.933200	-129	58.91400	45	55.99200	1524
Snow	-129.982450	45.927117	-129	58.94700	45	55.62702	1525
SnowBlower	-129.984067	45.939867	-129	59.04402	45	56.39202	1522
SteveMound	-130.013417	45.933250	-130	0.80502	45	55.99500	1547
Styx	-130.013700	45.933283	-130	0.82200	45	55.99698	1547
ThePit	-129.984083	45.939750	-129	59.04498	45	56.38500	1522
Tombstone	-130.011333	45.929483	-130	0.67998	45	55.76898	
Top-Gun	-129.979635	45.926472	-129	58.77810	45	55.58832	1520
Tunnicliffe	-130.015817	45.933667	-130	0.94902	45	56.02002	1546
Virgin	-130.013483	45.933650	-130	0.80898	45	56.01900	1547
VirginsDaughter	-130.013400	45.933750	-130	0.80400	45	56.02500	1547
Vixen	-129.993003	45.917280	-129	59.58018	45	55.03680	1538
White-Mkr-I	-130.013633	45.933733	-130	0.81798	45	56.02398	1545
BigJohnson	-130.013417	45.933363	-130	0.80502	45	56.00178	1542
Lamphere	-130.026562	45.989337	-130	1.59372	45	59.36022	1576
Shepherd	-130.027200	45.988868	-130	1.63200	45	59.33208	1580
T&S	-130.027168	45.989153	-130	1.63008	45	59.34918	1583

4.3.3 Vent Positions at Endeavour

The USBL navigation was not calibrated correctly for the dives at the Endeavour segment during the NeMO 2006 cruise. The following Endeavour vent position table is taken from the Ridge 2000 data portal on the Ridge 2000 website.

http://www.marine-geo.org/ridge2000/

S.M. Carbotte, R.Arko, D.N.Chayes, W.Haxby, K. Lehnert, S. O'Hara, W.B.F.Ryan, and R.A.Weissel, Lamont-Doherty Earth Observatory, Palisades,N.Y.; T. Shipley, L.Gahagan, and K. Johnson, University of Texas Institute for Geophysics,Austin; and T. Shank,Woods Hole Oceanographic Institution, Mass.New Integrated Data Management System for Ridge2000 and MARGINS Research, Eos,Vol. 85, No. 51, 21 December 2004.

Under the Endeavour segment study site there is a "Vent List" link. Vent locations for the Endeavour site data portal were provided by Deb Kelley and Deb Glickson (UW).

Area_Structure	Vent	Survey_Date	Longitude (°W)	Latitude (°N)	Details
High_Rise	Baltic	3/23/2005	-129.087475	47.967964	from Deb Glickson; March 2005
High_Rise	Bambi	3/23/2005	-129.086940	47.968638	from Deb Glickson; March 2005
High_Rise	Blue_Moon	3/23/2005	-129.088344	47.967649	from Deb Glickson; March 2005
High_Rise	Boardwalk	3/23/2005	-129.087341	47.968458	from Deb Glickson; March 2005
High_Rise	Clam_Bed	3/23/2005	-129.091954	47.963062	from Deb Glickson; March 2005
High_Rise	Fairy_Castle	3/23/2005	-129.087341	47.966884	from Deb Glickson; March 2005
High_Rise	Godzilla	3/23/2005	-129.087074	47.968818	from Deb Glickson; March 2005
High_Rise	Knight	3/23/2005	-129.088678	47.967289	from Deb Glickson; March 2005
High_Rise	Park_Place	3/23/2005	-129.087475	47.968189	from Deb Glickson; March 2005
High_Rise	Ventnor	3/23/2005	-129.089280	47.967784	from Deb Glickson; March 2005
MEF	Bastille	3/23/2005	-129.099376	47.947773	from Deb Glickson; March 2005
MEF	Crypto	3/23/2005	-129.096969	47.949661	from Deb Glickson; March 2005
MEF	Dante	3/23/2005	-129.097972	47.949212	from Deb Glickson; March 2005
MEF	Dudley	3/23/2005	-129.097571	47.948897	from Deb Glickson; March 2005
MEF	Easter_Island	3/23/2005	-129.099443	47.947998	from Deb Glickson; March 2005
MEF	Grotto	3/23/2005	-129.098641	47.949122	from Deb Glickson; March 2005
MEF	Hulk	3/23/2005	-129.097036	47.950111	from Deb Glickson; March 2005
MEF	Lobo	3/23/2005	-129.098574	47.949212	from Deb Glickson; March 2005
MEF	MilliQ	3/23/2005	-129.098908	47.947188	from Deb Glickson; March 2005
MEF	Salut	3/23/2005	-129.099109	47.947323	from Deb Glickson; March 2005
MEF	S&M	3/23/2005	-129.098507	47.947863	from Deb Glickson; March 2005
MEF	Sully	3/23/2005	-129.099176	47.947548	from Deb Glickson; March 2005
MEF	TP	3/23/2005	-129.097638	47.949392	from Deb Glickson; March 2005
Mothra	Bat_Tower	3/23/2005	-129.109071	47.921736	from Deb Glickson; March 2005
Mothra	Boomerang	3/23/2005	-129.109499	47.920773	from Deb Glickson; March 2005
Mothra	Brigid	3/23/2005	-129.109044	47.921817	from Deb Glickson; March 2005
Mothra	Cauldron	3/23/2005	-129.107453	47.925576	from Deb Glickson; March 2005
Mothra	Faulty_Towers	3/23/2005	-129.109004	47.923759	from Deb Glickson; March 2005
Mothra	Gwenen	3/23/2005	-129.109165	47.923112	from Deb Glickson; March 2005
Mothra	Hot_Harold	3/23/2005	-129.108630	47.923705	from Deb Glickson; March 2005
Mothra	Pinocchio	3/23/2005	-129.108603	47.923849	from Deb Glickson; March 2005
Mothra	Spikes	3/23/2005	-129.109258	47.921124	from Deb Glickson; March 2005
Mothra	Tower	3/23/2005	-129.108938	47.923669	from Deb Glickson; March 2005
Salty_Dawg	Grendl	3/23/2005	-129.075841	47.982129	from Deb Glickson; March 2005
Salty_Dawg	Salty_Dawg	3/23/2005	-129.076442	47.982129	from Deb Glickson; March 2005
Sasquatch	Pico	3/23/2005	-129.066373	47.997319	from Deb Glickson; March 2005

4.3.4 NeMO Instrument Mooring Positions

Instrument	Long (°W)	Lat (°N)	Depth of instrument on bottom	Height of mooring (glass ball flotation)	Depth of top of mooring	To be recovered and redeployed in 2007?
BPR05-middle	-130.00000	45.94265	1535	30	1505	Yes
BPR05-south	-130.00002	45.93332	1530	30	1500	NO
BPR04-center	-130.00833	45.95167	1530	50	1480	Yes
OBH4	-130.00943	45.95975	1534	40	1494	Yes
OBH3	-130.01780	45.93100	1423	40	1383	Yes
OBH2	-129.98295	45.91630	1532	40	1492	Yes
OBH1	-129.97462	45.93997	1518	40	1478	Yes

4.3.5 NeMO Transponder Positions

All Benthos XT-6000's, a 17-inch glass ball floating at the top of a 200-m long mooring line made of parachute chord. All were deployed in 2003 and used during cruises in 2003 and 2004, but not since. They all interrogate at 9.0 kHz.

Reply Frequency (kHz)	UTM X	UTM Y	Long (°W)	Lat (°N)	Depth (top of 200-m high mooring)	Enable Code	Disable Code
Lava Net							
10.5	424368	5088261	129.975763	45.943750	1308.21	A	B
8.5	424349	5086129	129.975673	45.924567	1320.87	A	B
11.5	422407	5086195	130.000728	45.924940	1326.71	A	B
7.5	421926	5087976	130.007223	45.940918	1336.26	A	B
CASM Net							
8.0	421279	5093140	130.016412	45.987312	1363.79	A	B
10.0	420510	5094426	130.026552	45.998798	1306.48	A	B
9.5	419661	5093074	130.037288	45.986528	1277.21	A	B

5.0 ROPOS DIVES - NeMO'06

5.1 ROPOS DIVE STATISTICS

7 dives total (R1008 - R1014). R1008 and R1009 at Endeavour. R1010 - R1014 at Axial.
Wet time: 124.63 hours
Bottom time: 78.75 hours
Samples: 122 total + subsamples

5.1.1 Bottom Times and Wet Times

All times are UTC

Dive#	Area	wet time in	bottom time start	bottom time stop	wet time out	wet hrs)	wet (min)	bottom (hrs)	bottom (min)
R1008	Mothra Endeavour	8/25 2345	8/26 0206	8/26 0600	0738	7	53	3	54
R1009	Main Field Endeavour	8/26 1753	2001	8/27 0853	1029	16	37	12	52
R1010	Axial caldera center to S Pillow Mound.	8/29 1515	1637	8/31 1918	2035	53	20	25	19
		Transits on pressure sensor dive R1010							
		8/29 1807-1907 buoy line to mid-caldera (Bmrk-63). [1 hr, 0 min]							
		8/29 2002-2157 mid-caldera to Magnesia Bmrk-1 (Mkr-67). [1 hr 55 min]							
		8/29 2350 - 8/30 0104 Magnesia to Mkr-33 (Bmrk-5). [1 hr 14 min]							
		8/30 0146 - 0314 Mkr-33 to Bag City (Bmrk-4 Mkr-65). [1 hr 28 min]							
		8/30 0448-0951 Bag City to S Pillow Mound (Bmrk-66). [5 hr 3 min]							
		8/30 1041-1450 S Pillow Mound to Bag City. [4 hr 9 min]							
		8/30 1547-1706. Bag City to Mkr-33. [1 hr 19 min]							
		8/30 1824-1923 Mkr33 to Magnesia. [55 min]							
		8/30 2017-2149 Magnesia to Caldera center. [1 hr 32 min]							
		8/30 2248-2330 Off the bottom dealing with the umbilical and pressure sensor problems. [42 min]							
		8/31 0014-0158 Caldera center to Magnesia. [1 hr 36 min]							
		8/31 0300-0356 Magnesia to Mkr-33. [56 min]							
		8/31 0714-0801 Cloud to Castle. [47 min]							
		8/31 0956-1105 Village to Vixen. 1 hr 9 min]							
		8/31 1154-1209 Vixen to Bag City. [15 min]							
		8/31 1329-1731 Bag City to S Pillow Mound. [4 hr 2 min]							
		28 hours 1 minutes total transit time above the bottom on dive R1010							
R1011	Northern 1998 lava flow	9/1 1507	1618	9/2 0141	0303	11	56	9	23
R1012	1998 lava flow	9/2 1513	1627	9/3 0029	0158	10	45	8	2
R1013	ASHES and caldera center	9/3 1505	1619	9/4 0206	0316	12	11	9	47
R1014	SE Caldera vents	9/4 1510	1622	9/5 0150	0306	11	56	9	28
TOTAL						**124**	**38**	**78**	**45**

5.2 ROPOS DIVE SUMMARIES - NeMO'06

All times are UTC

R1008 Mothra Field, Endeavour Segment. **[R1008 Bottom time: 8/26 0206 - 0600 (3 hrs 54 min)]** Launched the ROV with HFS, 3 gas-tights, vent cover and MTR in purse. Landed east of Faulty Towers. Used Homer 25 to find RAS site. Photographed site, but did not have time for any sampling or measurements before recovering instrument. Placed temperature recorder and intake on top of the RAS and pulled pin. While recovery of the mooring was in progress, the ROV was able to do some video observations. Following RAS recovery, we took a suction and HFS sample at Notre Dame (~100m south of Faulty Towers). Then returned to the RAS site at The Tower, took 1 HFS sample at the intake spot and a second ~ 30 cm away. We moved straight up to the top of The Tower to attempt a high-temperature water sample. The setup was too difficult and we were unable to get a sample. Time ran out and we had to end the dive. Only 3 samples successfully collected. Notre Dame: 1 SS, 1 HFS. The Tower RAS site: 1 HFS. Recovered RAS at Faulty Towers.

R1009 Main Endeavour Field, Endeavour Segment. **[R1009 Bottom time: 8/26 2001 - 8/27 0853 (12 hrs 52 min)]** Found the RAS immediately. Drove to SW Hulk site and documented the condition of 2005 RAS #17, stowed temperature sensor/intake. DSC survey. It was covered in furry microbial mat. Pulled pin and recovered RAS. Took video while waiting and ended up on West side of vent field. Crossed back over to RAS mooring. Released drop anchor and moved it to SW Hulk around S side of Crypto and deployed it for the year. Drove to Dudley, took diffuse and high-T samples and sulfide chimney sample in purse. Drove to S/M, took diffuse sample in basalt near original RAS/2000 observatory site. Attempted high-T sample but not successful. Moved to Easter Island, took last water sample and a DNA filter in diffuse vent. Some video survey. Took small chimney sample into sed/larval trap. Recovered sediment/larval trap for UVic and came to surface. Trap and chimney sample lost at 40m depth during recovery. Location noted. All HFS water samples used. 27 samples total. 25 retrieved at surface. MEF: 1 SS of sed. SW Hulk: 8 HFS, 1 gas. Dudley: 5 HFS, 1 gas, 1 rock. S&M: 3 HFS. Easter Island: 3 HFS, 2 SS, 1 rock, 1 sedtrap.

R1010 Axial caldera, '98 lava flow, S. Pillow Mound - Pressure dive. **[R1010 Bottom time: 8/29 1637 - 8/31 1918 minus 28 hours transit above the bottom (25 hrs 19 min)]** Started the dive looking at the NeMO Net anchor at the caldera center, hoping to get a clue about the disappearance of the NeMO Net buoy. Cut the line from the release up to the buoy so it would be free to recover on the next visit during this cruise. The line from the anchor toward the top end was stretched out about 50 meters to the NW. It looks like the buoy broke loose under relatively moderate conditions. It was not dragged, and the winds were likely from the SE. 3 pressure transects (at benchmarks at the caldera center; Magnesia; Mkr-33; Bag City; and South Pillow Mound). Deployed and recovered temperature probes (hobos and MTRs) on the 98 lava flow. *On this dive verified the navigation problem by doing some tests spinning the ship etc.* 9 samples total. Caldera center: 1SS of sed for glass. S of Magnesia: 1 SS of sed. for glass. Mkr-33: 2 SS sed for biota. Castle: 1 anhydrite piece, 1 SS blue mat, 1 grab of tubeworms and blue mat. Village: 1 SS of blue mat. Bag City: 1 SS sed for glass. Other vents visited include Cloud and Vixen. Discovered new diffuse venting near Magnesia and named the site Forum. Record breaking dive: > 53 hours long.

R 1011 Northern 1998 lava flow. **[R1011 Bottom time: 9/1 1618 - 9/2 0141 (9 hrs 23 min)]** Fluid sampling on the northern/mid section of the 1998 lava flow, and RAS deployment at Mkr-33. The dive started at Forum where fluid sampling began. Saw a line of diffuse venting as headed south - some on and around pillars like Forum. Sampled blue mat (ciliates) and water at Mkr-N3 site. Noticed diffuse venting at the edge of some collapse pits along the way. Found a large eruptive fissure, probably from the 1998 flow, between Mkr-N3 and Mkr-33 sites. Looked at the rumbleometer that has been down since 1998. Found the 2006 RAS sampler and deployed it at Marker-33 vent first sampling the area, recovering 1 limpet cage and 1 MTR. Moved on to Cloud for sampling. *Performed another nav offset test by spinning the ship.* 20 samples total. Enroute to Forum: 1 HFS for background DNA. Forum: 3 HFS, 1 gas. Between Forum and Mkr-N3: 1 SS of seds for glass. Mkr-N3: 3 HFS, 1 McLane, 1SS of blue mat, 1 biogeo grab of blue mat. 10 m from Mkr-N3: 1 SS of seds for glass. Mkr-33: 4 HFS, 1 gas, 1 McLane. Cloud: 1 SS of limpets.

R1012 1998 lava flow - E/W traverses. **[R1012 Bottom time: 9/2 1627 - 9/3 0029 (8 hrs 2 min)]** Completed 4 geological transects (E/W or W/E) across the 1998 lava flow to characterize lava features and types, observing lava flow boundaries along the way. Started in the southwest on the older lava flow. Traveled east to the topographic high north of castle. Next traveled north then west across the '98 flow. Headed north then east again, over the Mkr-33 area. Discovered venting to the west of Mkr-33 with small tubeworms and chemosynthetic clams (ChemoClams target). Also discovered new venting on pillars east of Mkr-33. Traveled north along the east edge of the flow, then westward across the flow (N of Mkr-N41). Discovered another large area of diffuse venting in a collapse/lava pillar area and dubbed it Zen Garden. Sampled lava pillars along the transects. Recovered a wood experiment for Verena. Recovered the rumbleometer north of Mkr-33 - out here since 1998. 7 samples total. 4 pillars (many pieces), 2 sediment samples for volcaniclastic glass, 1 bio sample (chemosynthetic clams).

R1013 ASHES. **[R1013 Bottom time: 9/3 1619 - 9/4 0206 (9 hrs 47 min)]** Fluid and biological sampling at ASHES. Took a bit of time re-acquainting ourselves with ASHES vent field, finding all the vent sites, etc. 29 samples total. Gollum: 4 HFS, 1 McLane. Mushroom: 2 HFS, 1 gas, 1 SS of blue mat. Inferno: 4 HFS, 2 gas. Hell: 2 HFS. Virgin: 3 HFS, 1 gas, 1 anhydrite piece. Recovered hobo 854 from Virgin (deployed 2004). Deployed hobo (miso) 104 at Virgin. 18 m NE of Hell: 1 worm hat grab. Phoenix: 2 SS (limpets and blue mat). Crack: 1 HFS. Marshmallow: 1 HFS. Transited along the bottom from ASHES to the caldera center. NE of ASHES: 1 SS of seds for volcaniclastic glass. Caldera center: 1 SS barnacles from the mooring line for dissolution studies. Recovered NeMO Net buoy acoustic release.

R1014 SE Caldera. **[R1014 Bottom time: 9/4 1622 - 9/5 0150 (9 hrs 28 min)].** No frame grabs until 1940:47 - mixup. SE caldera area exploration and sampling. Started out at Coquille vent field. HFS sampling in a tubeworm bush at a small, diffuse, unnamed vent west of Casper. Continued on to Casper for water sampling and hobo placement. Moved across the seafloor to Bag City, stopping first to suction sediments for volcaniclastic glass. Collected a pillar sample and discovered diffuse venting W of Bag City. Fluid sampling at Bag City. Discovered 2 new diffuse venting sites and tubeworms between Bag City and Mkr-113 Named the first small site "Grand Canyon", ~150m N or Bag City . The next site was dubbed "New Venting", a large area of mat, tubeworms and shimmering water ~90m S of Mkr-113. Continued on to Mkr-113 for fluid and biology sampling. Exploration in the area of Castle. Discovered several new active sulfide chimneys - the largest is > 13m tall and >330°C. Also several new (to us) diffuse vents in that area. 25 samples total. Small vent W of Casper: 4 HFS. Casper: 2 HFS, 1 gas. On the way to Bag City: 1 SS seds and 1 pillar sample. Bag City: 3 HFS. Mkr-13: 3 HFS, 2 SS of biota. El Guapo: 4 HFS, 2 gas. Diva: 1 SS blue mats and 1 bio grab. Noticed there was an offset between the MBARI SM2000 data and the navigation. The nav was putting us 20 - 30 meters west of the features we were observing in the Castle Area on the AUV map, even though it seemed to agree well for the first part of the dive (different AUV surveys)

5.3 ROPOS DIVE MAPS - NeMO'06

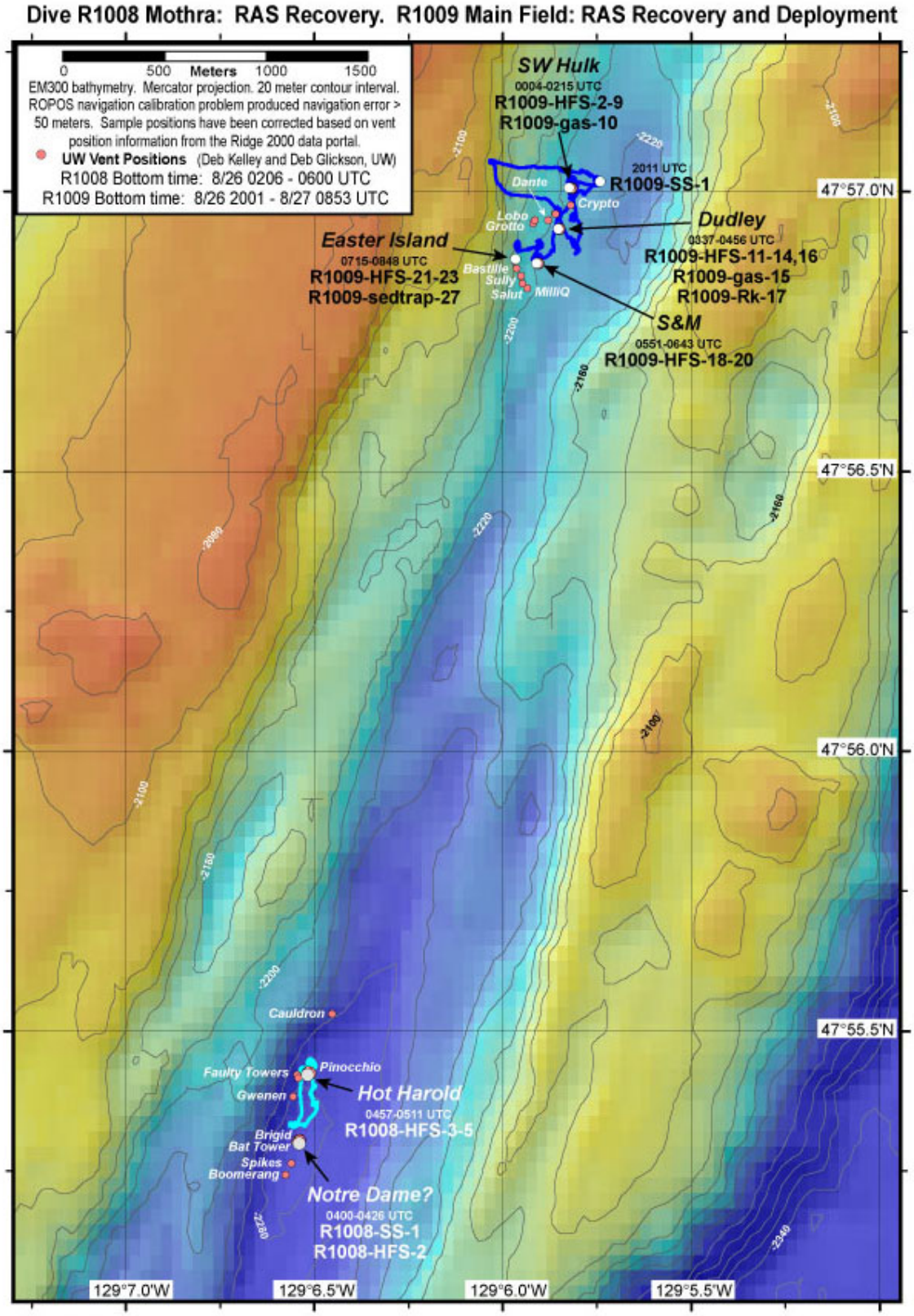

Figure 11

figure 11 back

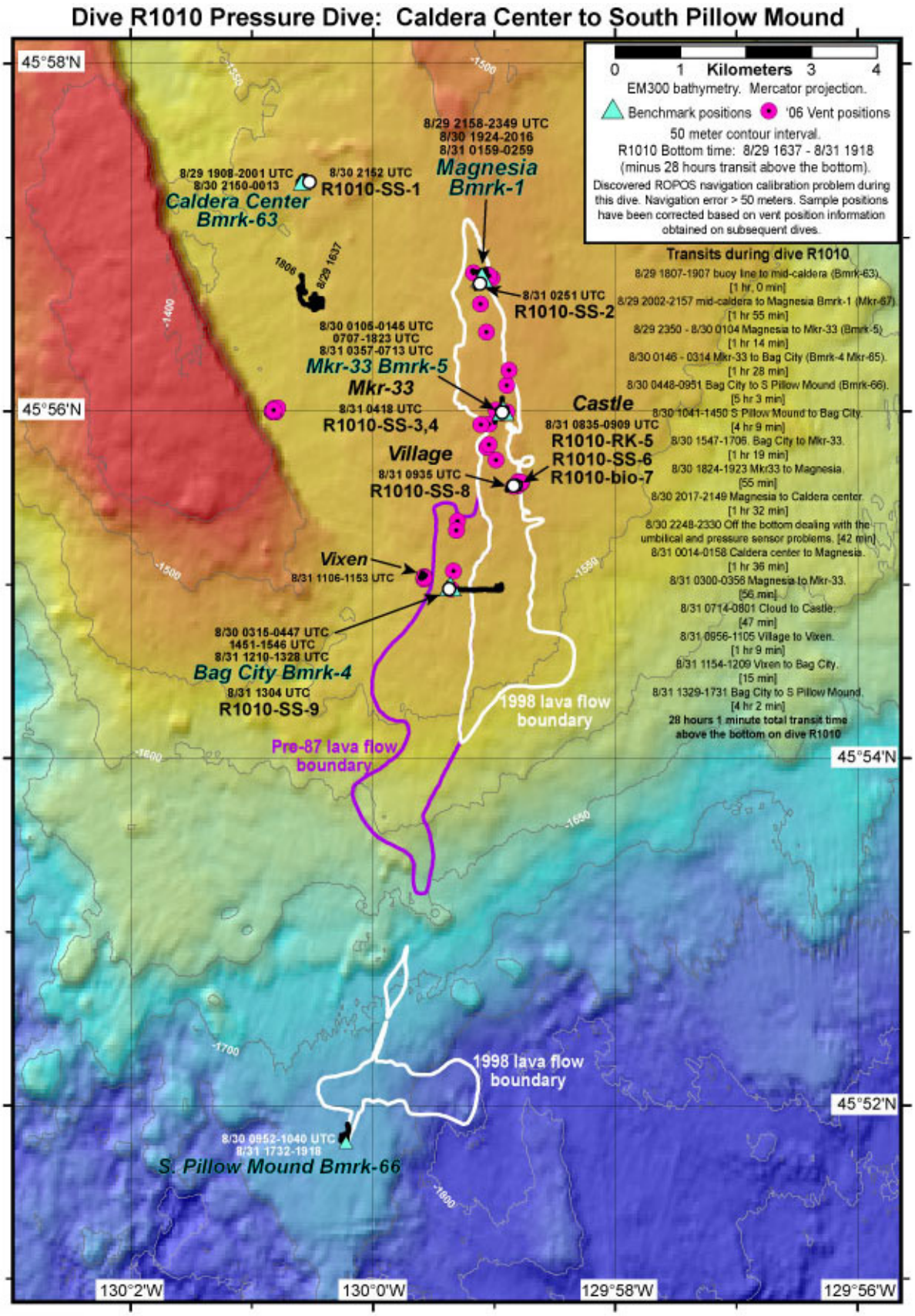
Dive R1010 Pressure Dive: Caldera Center to South Pillow Mound
0 1 Kilometers 3 4
EM300 bathymetry. Mercator projection.
Benchmark positions '06 Vent positions
50 meter contour interval.
R1010 Bottom time: 8/29 1637 - 8/31 1918
(minus 28 hours transit above the bottom).
Discovered ROPOS navigation calibration problem during this dive. Navigation error > 50 meters. Sample positions have been corrected based on vent position information obtained on subsequent dives.
Transits during dive R1010
8/29 1807-1907 buoy line to mid-caldera (Bmrk-63). [1 hr, 0 min]
8/29 2002-2157 mid-caldera to Magnesia Bmrk-1 (Mkr-67). [1 hr 55 min]
8/29 2350 - 8/30 0104 Magnesia to Mkr-33 (Bmrk-5). [1 hr 14 min]
8/30 0146 - 0314 Mkr-33 to Bag City (Bmrk-4 Mkr-65). [1 hr 28 min]
8/30 0448-0951 Bag City to S Pillow Mound (Bmrk-66). [5 hr 3 min]
8/30 1041-1450 S Pillow Mound to Bag City. [4 hr 9 min]
8/30 1547-1706. Bag City to Mkr-33. [1 hr 19 min]
8/30 1824-1923 Mkr33 to Magnesia. [55 min]
8/30 2017-2149 Magnesia to Caldera center. [1 hr 32 min]
8/30 2248-2330 Off the bottom dealing with the umbilical and pressure sensor problems. [42 min]
8/31 0014-0158 Caldera center to Magnesia. [1 hr 36 min]
8/31 0300-0358 Magnesia to Mkr-33. [56 min]
8/31 0714-0801 Cloud to Castle. [47 min]
8/31 0956-1105 Village to Vixen. [1 hr 9 min]
8/31 1154-1209 Vixen to Bag City. [15 min]
8/31 1329-1731 Bag City to S Pillow Mound. [4 hr 2 min]
28 hours 1 minute total transit time above the bottom on dive R1010
8/29 2158-2349 UTC
8/30 1924-2016
8/31 0159-0259
Magnesia Bmrk-1
8/29 1908-2001 UTC
8/30 2150-0013
Caldera Center Bmrk-63
8/30 2152 UTC
R1010-SS-1
1808
8/29 1637
8/31 0251 UTC
R1010-SS-2
8/30 0105-0145 UTC
0707-1823 UTC
8/31 0357-0713 UTC
Mkr-33 Bmrk-5
Mkr-33
8/31 0418 UTC
R1010-SS-3,4
Castle
8/31 0835-0909 UTC
R1010-RK-5
R1010-SS-6
R1010-bio-7
Village
8/31 0935 UTC
R1010-SS-8
Vixen
8/31 1106-1153 UTC
8/30 0315-0447 UTC
1451-1546 UTC
8/31 1210-1328 UTC
Bag City Bmrk-4
8/31 1304 UTC
R1010-SS-9
1998 lava flow boundary
Pre-87 lava flow boundary
1998 lava flow boundary
8/30 0952-1040 UTC
8/31 1732-1918
S. Pillow Mound Bmrk-66
45°58'N
45°56'N
45°54'N
45°52'N
130°2'W
130°0'W
129°58'W
129°56'W
-1500
-1400
-1600
-1650
-1700
-1800

Figure 12

figure 12 back

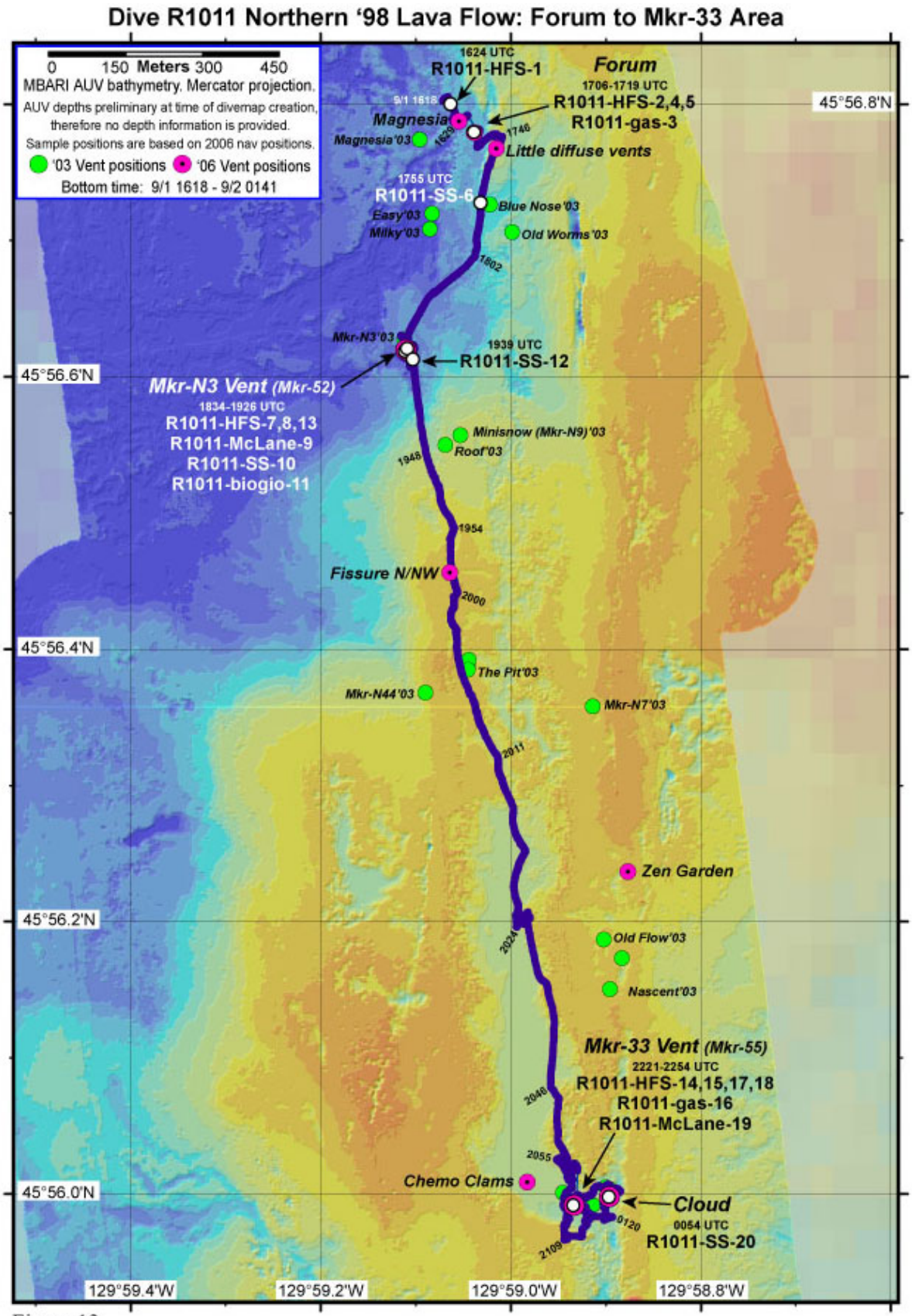
Dive R1011 Northern '98 Lava Flow: Forum to Mkr-33 Area
0 150 Meters 300 450
MBARI AUV bathymetry. Mercator projection.
AUV depths preliminary at time of divemap creation, therefore no depth information is provided.
Sample positions are based on 2006 nav positions.
'03 Vent positions '06 Vent positions
Bottom time: 9/1 1618 - 9/2 0141
1624 UTC
R1011-HFS-1
Forum
1706-1719 UTC
R1011-HFS-2,4,5
R1011-gas-3
9/1 1618
Magnesia
Magnesia'03
1629
1746
Little diffuse vents
1755 UTC
R1011-SS-6
Blue Nose'03
Easy'03
Milky'03
Old Worms'03
1802
Mkr-N3'03
1939 UTC
R1011-SS-12
Mkr-N3 Vent (Mkr-52)
1834-1926 UTC
R1011-HFS-7,8,13
R1011-McLane-9
R1011-SS-10
R1011-biogio-11
Minisnow (Mkr-N9)'03
Roof'03
1948
1954
Fissure N/NW
2000
The Pit'03
Mkr-N44'03
Mkr-N7'03
2011
Zen Garden
2024
Old Flow'03
Nascent'03
Mkr-33 Vent (Mkr-55)
2221-2254 UTC
R1011-HFS-14,15,17,18
R1011-gas-16
R1011-McLane-19
2048
2055
Chemo Clams
Cloud
0054 UTC
R1011-SS-20
0120
2109
45°56.8'N
45°56.6'N
45°56.4'N
45°56.2'N
45°56.0'N
129°59.4'W
129°59.2'W
129°59.0'W
129°58.8'W
Figure 13

figure 13 back

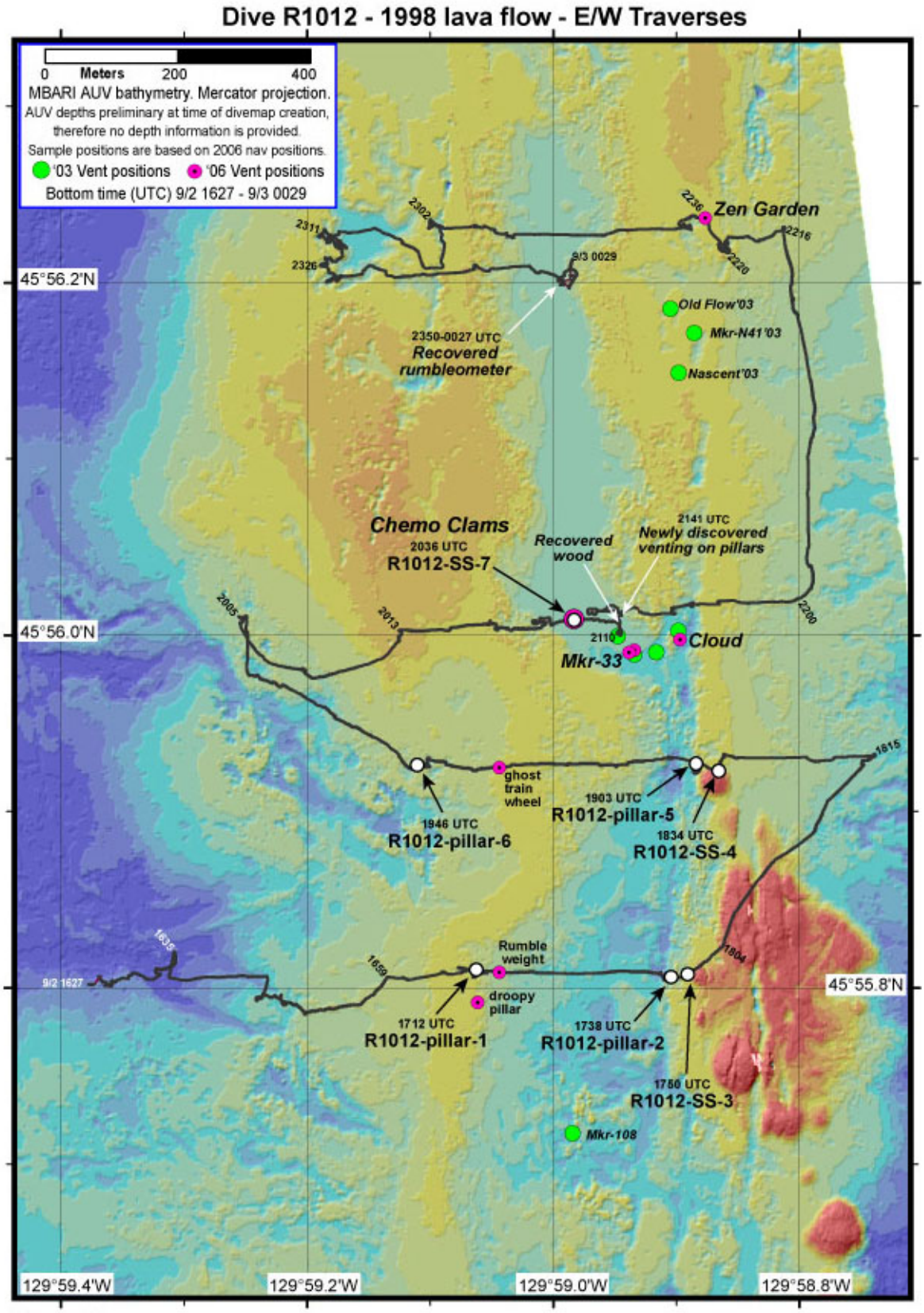
Dive R1012 - 1998 lava flow - E/W Traverses
0 Meters 200 400
MBARI AUV bathymetry. Mercator projection.
AUV depths preliminary at time of divemap creation, therefore no depth information is provided.
Sample positions are based on 2006 nav positions.
'03 Vent positions
'06 Vent positions
Bottom time (UTC) 9/2 1627 - 9/3 0029
45°56.2'N
45°56.0'N
45°55.8'N
129°59.4'W
129°59.2'W
129°59.0'W
129°58.8'W
Zen Garden
9/3 0029
2350-0027 UTC
Recovered rumbleometer
Old Flow'03
Mkr-N41'03
Nascent'03
Chemo Clams
2036 UTC
R1012-SS-7
Recovered wood
2141 UTC
Newly discovered venting on pillars
Cloud
Mkr-33
ghost train wheel
1946 UTC
R1012-pillar-6
1903 UTC
R1012-pillar-5
1834 UTC
R1012-SS-4
Rumble weight
droopy pillar
1712 UTC
R1012-pillar-1
1738 UTC
R1012-pillar-2
1750 UTC
R1012-SS-3
Mkr-108
9/2 1627

Figure 14

figure 14 back

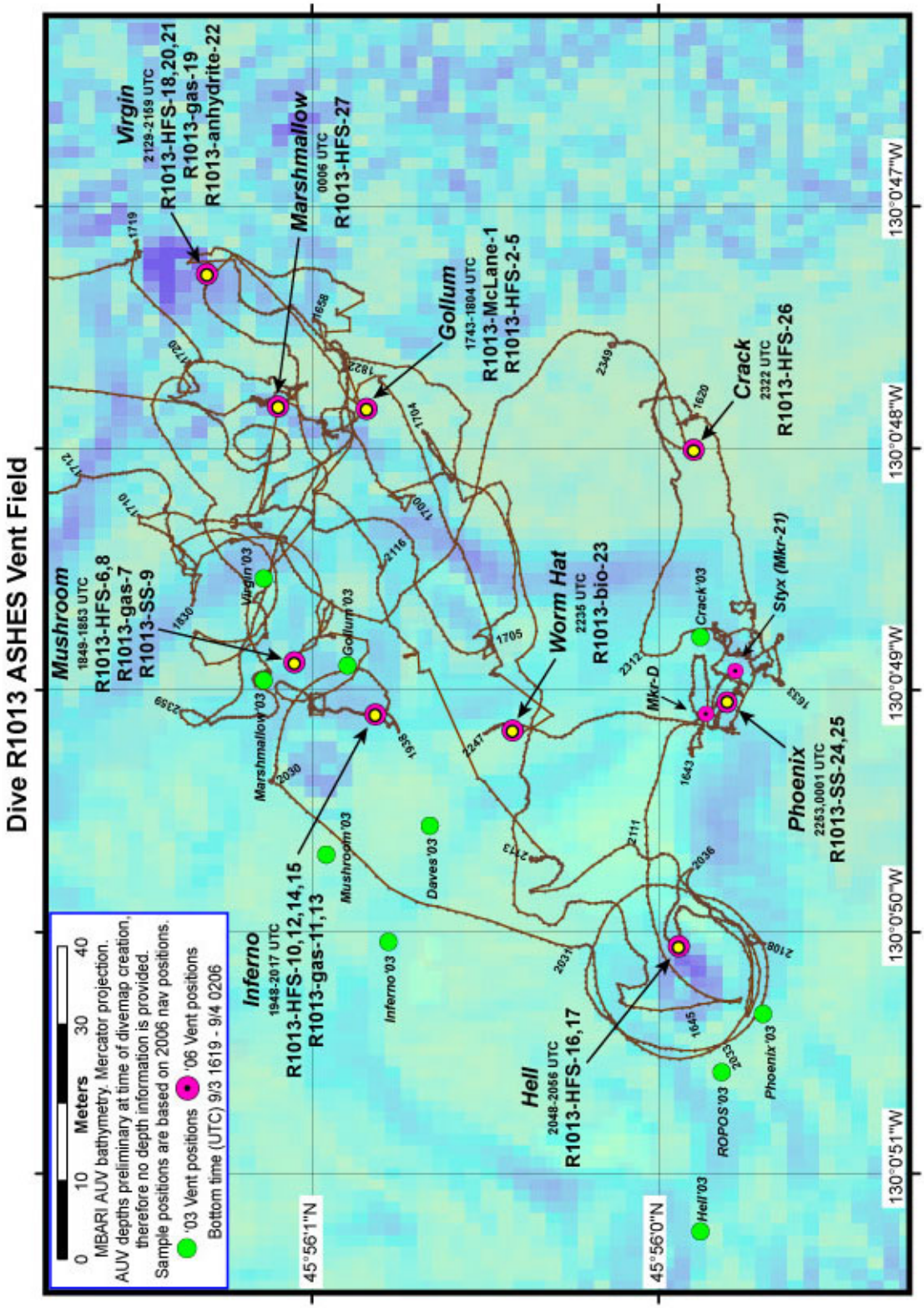
Dive R1013 ASHES Vent Field
Virgin
2129-2169 UTC
R1013-HFS-18,20,21
R1013-gas-19
R1013-anhydrite-22
Marshmallow
0006 UTC
R1013-HFS-27
Gollum
1743-1804 UTC
R1013-McLane-1
R1013-HFS-2-5
Crack
2322 UTC
R1013-HFS-26
Mushroom
1849-1853 UTC
R1013-HFS-6,8
R1013-gas-7
R1013-SS-9
Worm Hat
2235 UTC
R1013-bio-23
Styx (Mkr-21)
Mkr-D
Phoenix
2253,0001 UTC
R1013-SS-24,25
Inferno
1948-2017 UTC
R1013-HFS-10,12,14,15
R1013-gas-11,13
Hell
2048-2056 UTC
R1013-HFS-16,17
Virgin '03
Gollum '03
Marshmallow '03
Mushroom '03
Daves '03
Inferno '03
Crack '03
ROPOS '03
Phoenix '03
Hell '03
0 10 Meters 30 40
MBARI AUV bathymetry. Mercator projection.
AUV depths preliminary at time of divemap creation, therefore no depth information is provided.
Sample positions are based on 2006 nav positions.
'03 Vent positions
'06 Vent positions
Bottom time (UTC) 9/3 1619 - 9/4 0206
45°56'1"N
45°56'0"N
130°0'51"W
130°0'50"W
130°0'49"W
130°0'48"W
130°0'47"W

Figure 15

figure 15 back

Figure 16

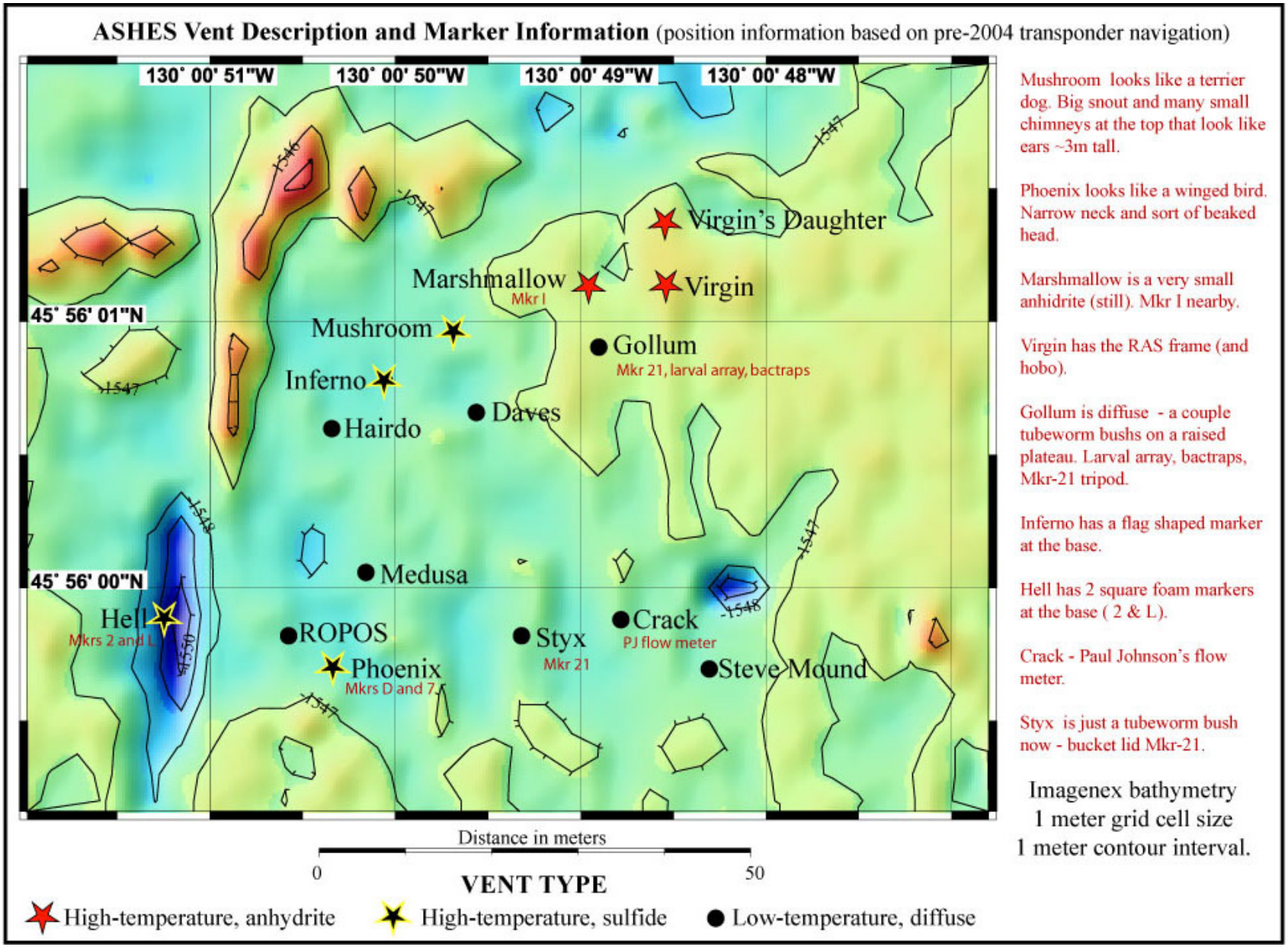
ASHES Vent Description and Marker Information (position information based on pre-2004 transponder navigation)
130° 00' 51"W
130° 00' 50"W
130° 00' 49"W
130° 00' 48"W
45° 56' 01"N
45° 56' 00"N
Virgin's Daughter
Marshmallow
Mkr I
Virgin
Mushroom
Gollum
Mkr 21, larval array, bactraps
Inferno
Hairdo
Daves
Medusa
Hell
Mkrs 2 and L
ROPOS
Phoenix
Mkrs D and 7
Styx
Mkr 21
Crack
PJ flow meter
Steve Mound
1546
1547
1548
1550
Distance in meters
0
50
VENT TYPE
High-temperature, anhydrite
High-temperature, sulfide
Low-temperature, diffuse
Mushroom looks like a terrier dog. Big snout and many small chimneys at the top that look like ears ~3m tall.
Phoenix looks like a winged bird. Narrow neck and sort of beaked head.
Marshmallow is a very small anhidrite (still). Mkr I nearby.
Virgin has the RAS frame (and hobo).
Gollum is diffuse - a couple tubeworm bushs on a raised plateau. Larval array, bactraps, Mkr-21 tripod.
Inferno has a flag shaped marker at the base.
Hell has 2 square foam markers at the base (2 & L).
Crack - Paul Johnson's flow meter.
Styx is just a tubeworm bush now - bucket lid Mkr-21.
Imagenex bathymetry
1 meter grid cell size
1 meter contour interval.

figure 16 back

Figure 17

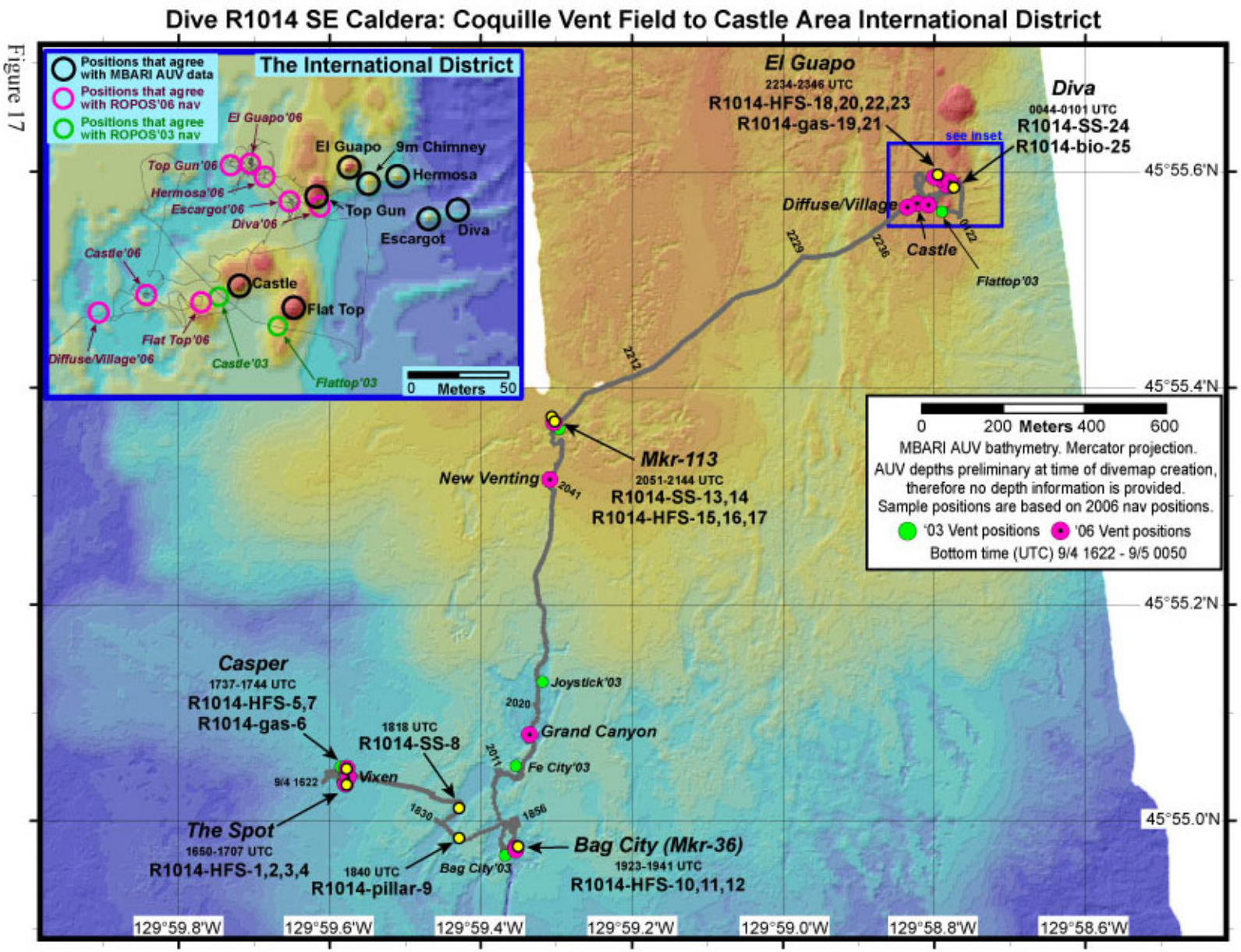
Dive R1014 SE Caldera: Coquille Vent Field to Castle Area International District
The International District
Positions that agree with MBARI AUV data
Positions that agree with ROPOS'06 nav
Positions that agree with ROPOS'03 nav
El Guapo'06
El Guapo
9m Chimney
Hermosa
Top Gun'06
Hermosa'06
Escargot'06
Top Gun
Diva'06
Escargot
Diva
Castle'06
Castle
Flat Top
Flat Top'06
Diffuse/Village'06
Castle'03
Flattop'03
0 Meters 50
El Guapo
2234-2346 UTC
R1014-HFS-18,20,22,23
R1014-gas-19,21
Diva
0044-0101 UTC
R1014-SS-24
R1014-bio-25
see inset
Diffuse/Village
Castle
Flattop'03
2229
2236
2242
2212
45°55.6'N
45°55.4'N
45°55.2'N
45°55.0'N
0 200 Meters 400 600
MBARI AUV bathymetry. Mercator projection.
AUV depths preliminary at time of divemap creation, therefore no depth information is provided.
Sample positions are based on 2006 nav positions.
'03 Vent positions
'06 Vent positions
Bottom time (UTC) 9/4 1622 - 9/5 0050
Mkr-113
2051-2144 UTC
R1014-SS-13,14
R1014-HFS-15,16,17
New Venting
2041
Casper
1737-1744 UTC
R1014-HFS-5,7
R1014-gas-6
1818 UTC
R1014-SS-8
Joystick'03
2020
Grand Canyon
2011
Fe City'03
9/4 1622
Vixen
1830
1856
The Spot
1650-1707 UTC
R1014-HFS-1,2,3,4
1840 UTC
R1014-pillar-9
Bag City'03
Bag City (Mkr-36)
1923-1941 UTC
R1014-HFS-10,11,12
129°59.8'W
129°59.6'W
129°59.4'W
129°59.2'W
129°59.0'W
129°58.8'W
129°58.6'W

figure 17 back

5.4 SEAFLOOR INSTRUMENT/EXPERIMENT DEPLOYMENTS AND RECOVERIES - NeMO'06

Vent/Marker	Experiment/ Instrument	Dive Deployed	Dive Recovered	Comments
Castle	Miso 102	**R1010 ('06)**		In Anhydrite
Castle	Hobo 152	R856 ('04)	**R1010 ('06)**	In Anhydrite
Cloud	MTR 3312	**R1010 ('06)**		MTRs 3312 and 3185 tied together Small hole at base of Mkr-69
Cloud	MTR 3185	**R1010 ('06)**		MTRs 3312 and 3185 tied together Small hole at base of Mkr-69
Cloud/Mkr-N6/21	MTR 3041	R855 ('04)	**R1010 ('06)**	MTRs 3041 and 3054 tied together
Cloud/Mkr-N6/21	MTR 3054	R855 ('04)	**R1010 ('06)**	MTRs 3041 and 3054 tied together
Cloud	Larval Array O	R659 ('02)	still there	S/SW of N6 ~8m
Coquille	MTR 3317	R551 ('00)		Couldn't find in 2002. Spotted on HFS dive R741 ('03) - not picked up
Gollum Vent	Larval Array J	R632 ('01)	still there	Spotted on R1013 ('06)
Mkr-113	MTR 1055	R627 ('01)		Couldn't find
Mkr-113	MTR 4126	R551 ('00)		Couldn't find
NW or Mkr-33	Rumble	1998	**R1012 ('06)**	Rumbleometer deployed in 1998
N or Mkr33	wood	2004?	**R1012 ('06)**	One of Verena's wood experiments
Mkr-33	Growth cage	R855 ('04)	**R1011 ('06)**	Noreen's limpet growth experiment
Mkr-33	gucci purses	R855 ('04)	**R1010 ('06)**	Richard's sulfide weathering experiment
Mkr-33	MTR 3026	R855 ('04)	**R1011 ('06)**	Green tape, mid-crack
Mkr-33	MTR 3039	R855 ('04)	**R1010 ('06)**	Yellow tape, north-crack
Mkr-33	MTR 3045	R855 ('04)	**R1010 ('06)**	Blue tape, south-crack
Mkr-33	MTR 3196	R855 ('04)	**R1010 ('06)**	Red tape, tubeworm bush
Mkr-33	MTR 3087	**R1010 ('06)**		east end of crack
Mkr-33	MTR 3197	**R1010 ('06)**		tubeworm bush near benchmark
Mkr-33	MTR 3201	**R1010 ('06)**		mid-crack near RAS
Mkr-33	MTR 3291	**R1010 ('06)**		west end of crack
Mkr-33	MTR 3042	**R1011 ('06)**		In the RAS dome
Mkr-33	Mkr-77	R743 ('03)	**gone in 06**	
Mkr-33	Mkr-55	**R1011 ('06)**		
T&S Spires	MTR 3017	R497 ('99)		
Virgin Vent	Miso 104	**R1013 ('06)**		
Virgin Vent	Hobo 127	R854 ('04)	**R1013 ('06)**	
Vixen (Coquille)	Hobo 128	R857 ('04)	**R1010 ('06)**	
Vixen (Coquille)	Hobo 153	R857 ('04)	**R1010 ('06)**	
Vixen (Coquille)	Miso 101	**R1010 ('06)**		Vent with Mkr-57 in it.
Casper (Coquille)	Miso 103	**R1014 ('06)**		
Vixen (Coquille)	Mkr-57	R857 ('04)		Just off Vixen mound
West-N3	Mkr-52	R856 ('04)		~10m west of old Mkr-N3 position

5.5 *ROPOS* SAMPLE LOGS - NeMO'06

Sample logs with lat-revised, long-revised columns indicate the revised positions of the samples based on known vent positions or believable processed navigation.

5.5.1 R1008 Sample Log - Mothra Field, Endeavour

Calibration error in 2006 ROPOS navigation. Vent locations revised based on the Ridge 2000 data portal, courtesy of Deb Kelley and Deb Glickson (UW).

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	Date	Samples R1008
R1008-SS-0001	Notre Dame?	47.92165	-129.10899	2299	179	04	00	Aug 26 2006	Suction sample jar 1. 180 micron mesh. Get whatever is here - probably limpets, tubeworms, snails, etc. Suction at the base of this 20 meter high chimney. Start 0402. Stop 0407. [Rose]
R1008-HFS-0002	Notre Dame?	47.92165	-129.10899	2282	191	04	26	Aug 26 2006	HFS filtered bag#7. Start 0426:20. Stop0430. Tmax=30.4 T2=16 Tavg=20.8 Vol=560ml. [Butterfield]
R1008-HFS-0003	Hot Harold	47.92371	-129.10863	2282	316	04	57	Aug 26 2006	HFS unfiltered bag#12. Tmax=3.3 Tavg=2.7. T2=2. Vol=505ml. 2005 Hot Harold intake site. [Butterfield]
R1008-HFS-0004	Hot Harold	47.92371	-129.10863	2282	290	05	06	Aug 26 2006	HFS filtered bag#9. Temp~60°. Tmax=62.2 Tavg=58.9. Vol=550ml. [Butterfield]
R1008-HFS-0005	Hot Harold	47.92371	-129.10863	2282	290	05	11	Aug 26 2006	HFS Sterivex filter#15. Start=0512. Stop=0513:23. Start2=0515:20 Stop2=0518:30. Start3=0522:30 Stop3=0528:59 Tmax=76.4 Tavg=53.7 T2=45. Vol=1329 ml. Lots of repositioning going on. Intake was a bit clogged. [Butterfield]

5.5.2 R1009 Sample Log - Main Endeavour Field

Calibration error in 2006 ROPOS navigation. Vent locations revised based on the Ridge 2000 data portal, courtesy of Deb Kelley and Deb Glickson (UW).

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	Date	Samples R1009
R1009-SS-0001	Main Endeavour Field	raw position 47.9503	raw position - 129.0957	2215	186	20	11	Aug 26 2006	Suction sample sediment into jar #7 (1mm mesh). Trying to get volcanic glass pieces that are (hopefully) in the sediments. Start 2013. Relocated slightly at 2022. Stop 2031. [Clague] THIS IS THE RAW NAVIGATION POSITION, PROBABLY ~50M N/NE OF ACTUAL POS.
R1009-HFS-0002	SW Hulk	47.95011	-129.09704	2210	179	00	04	Aug 27 2006	HFS filtered bag #7. Tmax=25.1 Tavg=21.9 T2=14 Vol=667mls. Sampling in crack where we did the temperature survey. [Butterfield]
R1009-HFS-0003	SW Hulk	47.95012	-129.09707	2210	179	00	11	Aug 27 2006	HFS unfiltered bag #12. Tmax=26.2 Tavg=17.9 T2=15.5 Vol=671mls. Same location as previous water sample. Actual start time 00:16. Temp dropped during sampling. Intake repositioned while still pumping. [Butterfield / Opatkiewicz]
R1009-HFS-0004	SW Hulk	47.95012	-129.09707	2210	178	00	21	Aug 27 2006	HFS Sterivex filter #15. Tmax=28.9 Tavg=26.3 T2=17 Vol=1766mls. Temperature was falling off a bit at the end of sampling. [Butterfield / Opatkiewicz]
R1009-HFS-0005	SW Hulk	47.95012	-129.09707	2209	181	01	31	Aug 27 2006	HFS filtered bag #8. Tmax=32 Tavg=28.9 T2=19 Vol=591mls. Actual start 01:31. Sampling in the vent cover oriface where the RAS will be deployed. [Butterfield]
R1009-HFS-0006	SW Hulk	47.95012	-129.09707	2209	181	01	38	Aug 27 2006	HFS unfiltered bag #13. Tmax=32.8 Tavg=31.7 T2=20 Vol=593mls. In vent cover where RAS will be deployed. [Butterfield / Opatkiewicz]
R1009-HFS-0007	SW Hulk	47.95012	-129.09707	2209	181	01	43	Aug 27 2006	HFS Sterivex filter #16. Tmax=32.8 Tavg=31.4 T2=19.5 Vol=2005mls. Sampling in vent cover where RAS will be deployed. [Butterfield / Opatkiewicz]
R1009-HFS-0008	SW Hulk	47.95012	-129.09707	2209	83	02	08	Aug 27 2006	HFS unfiltered piston #1. Tmax=298.3 Tavg=295.8 T2=104.3 Vol=385mls. Small smoker 2 meters east of RAS vent cover. [Butterfield]
R1009-HFS-0009	SW Hulk	47.95012	-129.09707	2209	83	02	13	Aug 27 2006	HFS filtered bag #9. Tmax=295.8 Tavg=290.6 T2=105.8 Vol=300mls. Small smoker 2 meters east of RAS vent cover. [Butterfield]

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	Date	Samples R1009
R1009-gas-0010	SW Hulk	47.95012	-129.09707	2209	83	02	15	Aug 27 2006	Gas tight bottle 5; hydraulic line #1. Tmax=295. Small smoker 2 meters east of RAS vent cover. [Evans]
R1009-HFS-0011	Dudley SE side	47.94890	-129.09757	2207	289	03	37	Aug 27 2006	HFS Unfiltered Bag sample #10. Tmax=17.0 Tavg=15.6 Vol=589mls. Sampling a small diffuse flow on the SE side of Dudley. End time 03:41. [Butterfield]
R1009-HFS-0012	Dudley SE side	47.94890	-129.09757	2207	289	03	44	Aug 27 2006	HFS Unfiltered Piston #4. Tmax=15.5 Tavg=14.3 Vol=740ml. Sampling a small diffuse flow on the SE side of Dudley. End time 03:48.50. [Butterfield]
R1009-HFS-0013	SE side of Dudley	47.94890	-129.09757	2207	289	03	51	Aug 27 2006	HFS Sterivex Filter #24. Tmax=16.7 Tavg=15.3 Vol=2028ml. End time=04:70.00. Sampling a small diffuse flow on the SE side of Dudley. [Butterfield]
R1009-HFS-0014	Top of Dudley	47.94890	-129.09757	2198	232	04	32	Aug 27 2006	HFS Unfiltered Bag #14. Tmax=? Tavg=?270? T2=140 Vol=511ml. Sampling on a black smoker. [Butterfield]
R1009-Gas-0015	Top of Dudley	47.94890	-129.09757	2198	232	04	34	Aug 27 2006	Taking gas tight bottle 15 - hydraulic line #3. Tavg=?270? T2=140. [Evans]
R1009-HFS-0016	Top of Dudley	47.94890	-129.09757	2198	231	04	39	Aug 27 2006	HFS unfiltered piston #2. Tmax=? Tavg=? T2=147. Vol=300-350ml. Sampling the black smoker on the top of Dudley. Stopping at 04:42.50. [Butterfield]
R1009-RK-0017	Dudley	47.94890	-129.09757	2198	334	04	56	Aug 27 2006	A small piece of the chimney has been collected into the purse. A second piece was added at 04:48. [Labonte]
R1009-HFS-0018	Base of S&M	47.94786	-129.09851	2201	173	05	51	Aug 27 2006	HFS Sterivex filter #23. Tmax=30.4 Tavg=20.6 T2=15 Vol=1513ml. Sampling a diffuse vent. Started at 05:54.45 and ends 06:06.57. Note: a short interruption in flow ~06:01. [Butterfield]
R1009-HFS-0019	Base of S&M	47.94786	-129.09851	2201	174	06	08	Aug 27 2006	HFS Filtered bag #11. Tmax=27.7 Tavg=20.1 T2=10 Vol=591ml. A small diffuse vent. Started 06:08.47 stopped at 06:13.30. [Butterfield / Opatkiewicz]
R1009-HFS-0020	25m up S&M	47.94786	-129.09851	2189	302	06	43	Aug 27 2006	HFS unfiltered piston #5. T1 is not functional Tmax=285.7 Tavg 280.7. T2=20-30 Vol=413ml. Actual start time ~06:46.00 end at 06:48.40. [Butterfield / Opatkiewicz]
R1009-HFS-0021	Tubeworm Vent at Easter Island	47.94800	-129.09944	2204	167	07	15	Aug 27 2006	HFS piston #3. T1 was unusable. T2=14-17 Vol=553ml Start time at 07:29.40 ended at 07:33.30. [Butterfield]
R1009-HFS-0022	Tubeworm Vent at Easter Island	47.94800	-129.09944	2204	170	07	35	Aug 27 2006	HFS Sterivex filter #22. T1 was non-functional. T2=13.3-15 Vol=2003ml. Sampling a diffuse vent. Started at 07:36.26 and ends 07:51. [Butterfield]
R1009-HFS-0023	Tubeworm Vent at Easter Island	47.94800	-129.09944	2204	169	07	53	Aug 27 2006	Sampling gastight bottle 11 - hydraulic line #2. 30 second sample. T2=13.3-15. [Evans]
R1009-SS-0024	Easter Island	47.94800	-129.09944	2205	273	08	12	Aug 27 2006	Suction sample rocks near the sediment trap into Jar 2. 180 micro mesh. Start 0812 Stop 0817. [Rose]
R1009-SS-0025	Easter Island	47.94800	-129.09944	2205	272	08	21	Aug 27 2006	Suction sample into jar 1 (180 micron mesh). Suctioning the surface of the sediment trap (which has been out here 3 years). Having a hard time..... Not much in the jar. [Rose]
R1009-RK-0026	Easter Island	47.94800	-129.09944	2205	232	08	42	Aug 27 2006	Piece of the top of this small squat chimney. Lots of flow coming out. Quite crumbly. Placed the piece in the sediment trap. Hopefully it will be there at the surface. Lost it with the sediment trap at surface! [Labonte]
R1009-sedtrap-0027	Easter Island	47.94800	-129.09944	2205	186	08	48	Aug 27 2006	Sediment trap (settling array) recovered after 3 years on the bottom. Purpose was to look for larval settlement. Has a rosette of 24 bottles that would move every 2 weeks (for a temporal study). Fell out of the arm at surface. Lost it! [Rose]

5.5.3 R-1010 Sample Log

Positions revised, where possible, based on subsequent 2006 ROPOS processed navigation. Calibration error in 2006 ROPOS navigation for this dive and previous dives at Endeavour.

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1010

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1010
R1010-SS-0001	Caldera Center	45.95534	-130.00872	1533	288	21	51	Aug 30 2006	Suction sediment #jar 6. Caldera center. Gravelly sediment on flat lineated sheet flow. Want to get a history of the lava flows here by looking at the chemistry of the glass fragments in the sediment. [Clague]
R1010-SS-0002	S of Magnesia	45.94556	-129.98523	1534	221	02	51	Aug 31 2006	Suction sample into jar #5. Grayish sediment down in the cracks and not the orange hydrothermal sediment. Location is 150 meters bearing 190 from Magnesia. [Clague]
R1010-SS-0003	Mkr-33	45.93319	-129.98223	1523	252	04	18	Aug 31 2006	Suction into jar #2 (180 micron mesh). Limpets in hydrothermal flow. [Rose]
R1010-SS-0004	Mkr-33	45.93319	-129.98223	1523	270	04	28	Aug 31 2006	Suction of limpets into jar #1 (180 micron mesh). The limpets are outside of the hydrothermal flow. [Rose]
R1010-RK-0005	Castle	45.92618	-129.98038	1521	39	08	35	Aug 31 2006	A piece of the anhydrite chimney. Placed in the boot. It broke into 2 pieces. [Labonte]
R1010-SS-0006	Castle	45.92618	-129.98038	1519	317	09	01	Aug 31 2006	Suction blue mat (ciliates) into jar #3 (200 micron mesh). It's obvious the blue mats are exposed to the flow and receiving fluids from the vents. [Kouris]
R1010-bio-0007	Castle	45.92618	-129.98038	1520	300	09	09	Aug 31 2006	Grabbed tubeworm clump with blue mat (ciliates). The clump was above the anhydrite chimney. Lots of ciliates among the tubeworms. [Kouris]
R1010-SS-0008	Village	45.92612	-129.98060	1523	336	09	35	Aug 31 2006	Suction blue mat into jar #4 (200 micron mesh). When we try to grab a mat-encrusted rock it keeps crumbling. Went for a suction instead of a rock grab.[Kouris]
R1010-SS-0009	Bag City	45.91622	-129.98946	1534	175	13	04	Aug 31 2006	Suction sample into jar #7. Light sediment covering on lavas about 3 m north of the Bag City benchmark. Repositioned once to get more sediment. [Clague]

5.5.4 R-1011 Sample Log

Positions revised based on 2006 ROPOS processed navigation.

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1011
R1011-HFS-0001	en-route to Forum	45.94667	-129.98439	1526	264	16	24	Sep 01 2006	Sterivex #24 filter to get the background DNA. Tmax=2.5°C; Tavg=2.4°C; T2=2.4°C; Vol=1261ml End time=16:38. It is starting and stopping a lot. It was stopped as we arrived at Forum. [Butterfield]
R1011-HFS-0002	Forum	45.94632	-129.98398	1529	111	17	06	Sep 01 2006	HFS Filtered bag #7. Tmax=91.2°C; Tavg=74.4°C; T2=50°C; Vol=464ml; End time=17:09.50. [Butterfield]
R1011-GAS-0003	Forum	45.94632	-129.98398	1529	111	17	09	Sep 01 2006	Gas tight bottle #15. Tmax=91.2°C; Tavg=74.4°C; T2=50°C. [Evans]
R1011-HFS-0004	Forum	45.94632	-129.98398	1529	111	17	12	Sep 01 2006	HFS Unfiltered Piston #1. Tmax=83.7°C; Tavg=80.5°C; T2=50°C; Vol=800ml. End time=17:17.14. [Butterfield]
R1011-HFS-0005	Forum	45.94632	-129.98398	1529	111	17	19	Sep 01 2006	HFS DNA filter #23. Tmax=92.6°C; Tavg=83.4°C; T2=50°C; Vol=2162ml. End time=17:34. [Butterfield]
R1011-SS-0006	~200 m N of N3	45.94546	-129.98386	1527	191	17	55	Sep 01 2006	Suction sediment for glass fragments - into Jar #5 (1mm mesh). Between Forum and Marker-N3 Vent (somewhere). [Clague]
R1011-HFS-0007	Mkr-N3	45.94364	-129.98518	1530	12	18	34	Sep 01 2006	HFS filtered bag #8. Tmax=24.3°C; Tavg=23.3°C; T2=18°C; Vol=510ml; End time=18:37. [Butterfield]
R1011-HFS-0008	Mkr-N3	45.94364	-129.98518	1530	12	18	39	Sep 01 2006	HFS Unfiltered Piston #2. Tmax=24.7 °C; Tavg=24.4 °C; T2=18 °C; Vol=800 ml; End time=1845. [Butterfield]
R1011-HFS-0013	Mkr-N3	45.94364	-129.98518	1530	12	18	47	Sep 01 2006	(This sample was logged out of order originally). HFS unfiltered bag #13. Tmax=24.6°C; Tavg=24.3°C; T2=17.5°C; Vol=524 ml; End time=1851. [Butterfield]
R1011-McLane-0009	Mkr-N3	45.94364	-129.98519	1530	11	19	05	Sep 01 2006	Starboard McLane filter sample. Start 1854. Stop 1855:45. 19.5 liters. Tavg=24.7. Stable temperature. (Logged out of order) [Bolton]
R1011-SS-0010	Mkr-N3	45.94364	-129.98519	1530	11	19	06	Sep 01 2006	Suction sample blue mat (ciliates) into jar #3 (200 micron double mesh). Large patch of blue mat sampled. Start 1905. Stop 1913. [Kouris]

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1011
R1011-biogeo-0011	Mkr-N3	45.94367	-129.98515	1528	133	19	26	Sep 01 2006	Grabbed 2 pieces of rock ledge with lots of blue mat (ciliates). Looks like the blue mat was attached to a surface area and lots slipped off during sampling. Placed in the purse. [Kouris]
R1011-SS-0012	15m SE of Mkr-N3	45.94355	-129.98504	1530	202	19	39	Sep 01 2006	Suction sediments into jar #4 (200 micron double mesh). Will serve as a control for Angela's blue mat studies. There are no mat in this non-venting area about 15m SE of the last sample. Start 1943 Stop 1944:30. [Kouris]
R1011-HFS-0014	Mkr-33	45.93319	-129.98223	1524	204	22	21	Sep 01 2006	HFS filtered bag #9 in the RAS dome hole. Temp range is 18°-19C. Doesn't appear to be working. Tmax=19.2°C; Tavg=18.6°C; T2=13.2°C; Vol=608ml; End time=2224 Z=1524. Probably didn't work. [Butterfield]
R1011-HFS-0015	Mkr-33	45.93319	-129.98223	1524	204	22	26	Sep 01 2006	HFS filtered bag #10. Tmax=18.9°C; Tavg=18.3°C; T2=13.0°C; Vol=586 ml; End time=2229. Z=1524. This one is working. [Butterfield]
R1011-Gas-0016	Mkr-33	45.93319	-129.98223	1524	204	22	28	Sep 01 2006	Gastight #11. Temp=17.8°C. In same area as previous (present) HFS sample #14. [Evans]
R1011-HFS-0017	Mkr-33	45.93319	-129.98223	1524	204	22	32	Sep 01 2006	HFS unfiltered piston #3. Tmax=18.5°C; Tavg=18.0°C; T2=13.0°C; Vol=711 ml; End time=2236. [Butterfield]
R1011-HFS-0018	Mkr-33	45.93319	-129.98223	1524	204	22	37	Sep 01 2006	HFS Sterivex filter #17. Tmax=18.6°C; Tavg=18.0°C; T2=13.0°C; Vol=2033 ml; End time=2253. [Butterfield]
R1011-McLane-0019	Mkr-33	45.93319	-129.98223	1524	204	22	54	Sep 01 2006	High volume McLane sample. Temp=17-18°C during sampling. Vol=20.7 liters. End time=2258. [Bolton]
R1011-SS-0020	Cloud	45.93330	-129.98161	1526	357	00	54	Sep 02 2006	Suction sample into Jar #1 (180 micron filter). Suctioning limpets off of the tubeworms at the edge of the pit. Relocated mid sample to find more limpets. [Rose]

5.5.5 R-1012 Sample Log

Positions revised based on 2006 ROPOS processed navigation.

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1012
R1012-pillar-0001	Near WP2	45.93017	-129.98437	1523	334	17	12	Sep 02 2006	A piece of a pillar - the stump of one that had fallen over with a clear inner surface. Port-aft portion of the bio box. A second piece was added at 17:19. (West edge of 1998 flow near VSM2 site) [Chadwick]
R1012-pillar-0002	Near WP 3.	45.93010	-129.98173	1523	276	17	38	Sep 02 2006	A piece of a pillar - as with the first sample this is a fallen over stump. Port-Forward section of the bio box. A second piece added at 17:41. A third at 17:42. (Eastern edge of the 1998 lava collapse) [Chadwick]
R1012-SS-0003	WP3	45.93012	-129.98151	1521	102	17	50	Sep 02 2006	Sampling sediment for the volcanic glass. Into Jar #5 with 1mm mesh size. [Clague]
R1012-SS-0004	115m SE of Mkr- 33	45.93205	-129.98109	1519	169	18	34	Sep 02 2006	Suction sediment for volcanic glass into Jar #6. It has 1mm mesh. [Clague]
R1012-pillar-0005	In collapse area.	45.93212	-129.98140	1523	352	19	3	Sep 02 2006	Picked up an end piece of this pillar. Quite a large piece. Placing in the stbd aft biobox. (W of WP4 E side of 1998 flow) [Chadwick]
R1012-pillar-0006	Close to WP 5	45.93211	-129.98517	1524	171	19	46	Sep 02 2006	Piece of rind from this older lava pillar (pre-1998 flow). We knocked this pillar over. Grabbed a couple pieces of the pillar stump. Right forward biobox. (east of WP5) [Chadwick]
R1012-SS-0007	Chemo Clams	45.93348	-129.98305	1524	94	20	36	Sep 02 2006	Suction chemosynthetic clams into jars #1;2;7. Too large for the hose. Some iron-type seds and tiny tubeworms too. Put a few clams into port rear biobox. Will try to get a couple more in biobox. 68 m W of Mkr-33. (Chemo Clams target). [Rose]

5.5.6 R-1013 Sample Log

Positions revised based on 2006 ROPOS processed navigation.

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1013
R1013-McLane-0001	Gollum	45.93357	-130.01329	1546	25	17	43	Sep 03 2006	McLane pump sample. Temperature jumped to 20°C. Stopped after 4 liters. Started again at 18:02 for another 4 liter sample. Started again and stopped for a total of 20 liters. [Butterfield]

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1013
R1013-HFS-0002	Gollum	45.93357	-130.01329	1546	25	17	44	Sep 03 2006	HFS piston sample #1. Taken at the same time as the McLane pump sample. Tmax=20.4°C T2=12.2°C. Endtime=17:46. Stopped early as it may not have triggered well. Sample didn't work. [Butterfield]
R1013-HFS-0003	Gollum	45.93357	-130.01329	1546	25	17	48	Sep 03 2006	HFS Unfiltered bag #12. Tmax=32.2°C Tavg=29.3C. Vol=596ml. Endtime=17:51.30. T1 jumped so it is definitely working. [Butterfield]
R1013-HFS-0004	Gollum	45.93357	-130.01329	1546	25	17	54	Sep 03 2006	HFS Filtered Piston #5. Tmax=29.5°C Tavg=26.0°C. Vol=800ml. Endtime=18:00.30. It also seems to be working. [Butterfield]
R1013-HFS-0005	Gollum	45.93357	-130.01329	1546	25	18	04	Sep 03 2006	HFS DNA Filter #18. Tmax=29.8°C Tavg=24.6°C T2=12°C. Vol=2321ml. Endtime=18:20. [Butterfield]
R1013-gas-0007	Base of Mushroom	45.93363	-130.01358	1547	52	18	49	Sep 03 2006	Gastight #4 hydraulic line 4. Temp 64°C. Start 1850. [Evans]
R1013-HFS-0006	Base of Mushroom	45.93363	-130.01358	1547	52	18	46	Sep 03 2006	HFS unfiltered piston sample #2. Tmax=80.5°C Tavg=58.3°C T2=40.0°C. Vol=800 ml. Endtime=1851. The piston is moving - that's good. [Butterfield]
R1013-HFS-0008	Base of Mushroom	45.93363	-130.01358	1547	52	18	53	Sep 03 2006	HFS filtered bag #7. Tmax=62°C Tavg=56°C. Vol=587ml. Endtime=1858. Temp is probably close to 300°C. Lots of seawater entrained so temp is inaccurate. [Butterfield]
R1013-SS-0009	near base of Mushroom	45.93360	-130.01355	1547	292	19	09	Sep 03 2006	Suctioning blue mat at the base of Mushroom under the nose (200 micron double mesh) into jar #3. The base is a small anhydrite complex (~0.5 meters tall with several chimneys). [Kouris]
R1013-HFS-0010	Inferno	45.93356	-130.01364	1544	306	19	48	Sep 03 2006	HFS filtered bag #8. In a beehive toward the top of Inferno. Tmax=284°C Tavg=278°C T2=120°C. Vol=460ml. Endtime=1950:54. Because of the heat the manifold is flushing itself. [Butterfield]
R1013-gas-0011	Inferno beehive	45.93356	-130.01364	1544	306	19	52	Sep 03 2006	Gastight #6 Hydraulic line 3. Tmax was 284C. In the beehive where previous HFS was taken. [Evans]
R1013-HFS-0012	Inferno beehive	45.93356	-130.01364	1544	306	19	54	Sep 03 2006	HFS unfiltered piston #3. Same place as last sample. Tmax=274°C Tavg=268°C T2=25°C. Vol=645ml. Endtime=1958. [Butterfield]
R1013-gas-0013	Inferno	45.93356	-130.01364	1544	311	20	05	Sep 03 2006	Gastight #2 hydraulic line 2. Fired at 2005. Temp is ~307°C Temp was 245°C during sampling. [Evans]
R1013-HFS-0014	Inferno	45.93356	-130.01364	1544	311	20	06	Sep 03 2006	HFS unfiltered bag #13. In this huge flow out of a broken off beehive. Tmax=260°C Tavg=249°C T2=20°C. Vol=433ml. Endtime=2009. [Butterfield]
R1013-HFS-0015	Inferno beehive area	45.93356	-130.01364	1544	306	20	17	Sep 03 2006	HFS unfiltered bag #14. Tmax=300C Tavg=295C. Vol=500ml. Endtime=2020:20. This sample didn't work. [Butterfield]
R1013-HFS-0016	Hell - beehive near the top	45.93332	-130.01391	1543	280	20	48	Sep 03 2006	HFS bag #11. Here at Hell in this beehive surrounded by biota. Tmax=127°C Tavg=111°C. Vol=549ml. Endtime=2051:30. The sampler fixed itself. The flush pump works. [Butterfield]
R1013-HFS-0017	Hell beehive near the top	45.93332	-130.01391	1543	280	20	56	Sep 03 2006	HFS unfiltered piston #4. Tmax=105°C Tavg=93°C T2=~30°C. Vol=811ml. Endtime=2101. [Butterfield]
R1013-HFS-0018	Virgin	45.93370	-130.01313	1546	169	21	29	Sep 03 2006	HFS filtered piston #6. Tmax=244°C Tavg=235°C T2=100°C. Vol=469ml. Endtime=2131:30. The chimney has fallen and we're sampling the base. [Butterfield]
R1013-gas-0019	Virgin	45.93370	-130.01313	1546	169	21	33	Sep 03 2006	Gastight #7 hydraulic channel #1. Same spot as previous sample. T=248C. Start 2133:20. [Evans]
R1013-HFS-0020	Virgin	45.93370	-130.01313	1546	169	21	35	Sep 03 2006	HFS filtered bag #9. Tmax=248.7°C Tavg=244.7°C T2=117°C. Vol=273ml. Endtime=2136:50. [Butterfield]
R1013-HFS-0021	Virgin	45.93370	-130.01313	1546	169	21	38	Sep 03 2006	HFS filtered bag #10. Tmax=252.3°C Tavg=248°C T2=113°C. Vol=339ml. Endtime=2142:40. [Butterfield]
R1013-anhydrite-0022	Virgin	45.93370	-130.01313	1546	167	21	59	Sep 03 2006	Suctioning the anhydrite up (the flush bottle #8 is at the end) and then dropping it in the purse. Got one small piece of anhydrite. One larger angular piece with sulfide. A couple small fresh pieces from the top. [Labonte]

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1013
R1013-bio-0023	~25m NE of Hell	45.93345	-130.01366	1547	252	22	35	Sep 03 2006	Grab of this "worm hat". We want alvinellid worms. Got quite a large batch of the worms from the top of the hat. Lots of it still remains on the seafloor in good shape. [Rose]
R1013-SS-0024	Phoenix	45.93328	-130.01362	1547	233	22	53	Sep 03 2006	Suctioning limpets into jar #1 with 180 micron mesh. Taken from the base of the structure on Phoenix in a dense tubeworm bush. [Rose]
R1013-SS-0025	Phoenix	45.93328	-130.01362	1547	125	23	01	Sep 03 2006	Suctioning blue mats into jar #4 with a 200 micron double mesh sieve. Taken from the NW side of Phoenix near the base. [Kouris]
R1013-HFS-0026	Crack	45.93331	-130.01334	1546	111	23	22	Sep 03 2006	HFS Sterivex filter #22. Tmax=50.6 Tavg=49 T2=33. Vol=3010ml. Taken at the base of Paul Johnson's cement box with flow meter. Temperature is very stable. [Butterfield / Opatkiewicz]
R1013-HFS-0027	Marshmallow	45.93364	-130.01329	1546	26	00	06	Sep 04 2006	HFS Sterivex filter #21. Tmax=106.8 Tavg=96.8 T2=65. Vol=2154ml. [Butterfield / Opatkiewicz]
R1013-SS-0028	~150m N/NE of ASHES	45.93480	-130.01290	1548	0	00	35	Sep 04 2006	Suctioning the sediments for volcanic glass. Into jar#5 with a 1mm mesh size. Stopped at 00:43. Sampled while traversing from ASHES to the caldera center. [Clague]
R1013-SS-0029	Caldera center	45.94587	-130.00957	1548	60	01	45	Sep 04 2006	Suctioning barnacles from the mooring line for dissolution studies. Suction jar #6. [Rose]

5.5.7 R-1014 Sample Log

Positions revised based on 2006 ROPOS processed navigation.

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1014
R1014-HFS-0001	The Spot	45.91724	-129.99299	1538	188	16	50	Sep 04 2006	HFS unfiltered piston #1. Tmax=28.6°C Tavg=27°C T2=15°C. Vol=Low; Endtime=16:53. Sample may not have worked. This is a small diffuse vent S of Vixen. [Butterfield]
R1014-HFS-0002	The Spot	45.91724	-129.99299	1538	188	16	55	Sep 04 2006	HFS unfiltered piston #2. Tmax=29.5°C Tavg=28.4°C T2=15°C. Vol=698ml. Endtime=16:59. This one is working well unlike piston #1. This is a small diffuse vent S of Vixen. [Butterfield]
R1014-HFS-0003	The Spot	45.91724	-129.99299	1538	188	17	00	Sep 04 2006	HFS Filtered bag #7. Tmax=29.7°C Tavg=28.5°C T2=15°C. Vol=594ml. Endtime=17:04. This is a small diffuse vent S of Vixen. [Butterfield]
R1014-HFS-0004	The Spot	45.91724	-129.99299	1538	189	17	07	Sep 04 2006	HFS Sterivex filter #18. Tmax=30.7°C Tavg=29.6°C T2=15.5°C. Vol=2384m. Endtime=17:24. This is a small diffuse vent S of Vixen. [Butterfield]
R1014-HFS-0005	Casper	45.91748	-129.99296	1538	205	17	37	Sep 04 2006	HFS unfiltered piston #3. Tmax=290.4°C Tavg=289.9°C T2=89°C. Vol=700ml. Endtime=17:41. [Butterfield]
R1014-GAS-0006	Casper	45.91748	-129.99296	1538	205	17	40	Sep 04 2006	Gas tight bottle #11. Successful trigger. Temperature was 290°C. T2=89°C. [Evans]
R1014-HFS-0007	Casper	45.91748	-129.99296	1538	205	17	44	Sep 04 2006	HFS Filtered bag #9. Tmax=291.4°C Tavg=290.8°C T2=88°C. Vol=292ml. Endtime=17:45. [Butterfield]
R1014-SS-0008	125m W/NW of Bag City	45.91685	-129.99044	1539	184	18	18	Sep 04 2006	Suction sample for volcanic glass into suction Jar #5. Finished at 18:26. (on sheet flow) [Clague]
R1014-pillar-0009	100m W of Bag City	45.91640	-129.99052	1537	167	18	40	Sep 04 2006	Piece of pillar. We're on the older flow. Grabbing some small chunks and a big piece with a brittle star. Z=1537. On our way from Vixen to Bag City. [Chadwick]
R1014-HFS-0010	Bag City (Mkr-36 area)	45.91631	-129.98916	1536	216	19	23	Sep 04 2006	HFS unfiltered bag #12. Tmax=15.1°C Tavg=14.7°C T2=~12°C. Vol=580ml. Starttime=1930:45 Endtime=1934:20. In healthy tubeworm bush at Bag City. [Butterfield]
R1014-HFS-0011	Bag City (Mkr-36 area)	45.91631	-129.98916	1536	216	19	36	Sep 04 2006	HFS filtered bag #8. Tmax=15.2°C Tavg=14.7°C T2=12°C. Vol=590ml. Endtime=1939:25. In healthy tubeworm bush. [Butterfield]
R1014-HFS-0012	Bag City (Mkr-36 area)	45.91631	-129.98916	1536	216	19	41	Sep 04 2006	HFS sterivex filter #15. Tmax=15.5°C Tavg=14.9°C T2=12°C. Vol=3010ml. Endtime=2005:00. [Butterfield]
R1014-SS-0013	Mkr-113	45.92282	-129.98841	1525	97	20	51	Sep 04 2006	Suction limpets and other biota into jar #1 (180 micron mesh). Endtime=2054. This area is lush and jam packed with biota. [Rose]

Sample	Location	lat-revised	long-revised	Z	Hdg	hr	min	date	Samples R1014
R1014-SS-0014	Mkr-113	45.92282	-129.98841	1525	102	20	57	Sep 04 2006	Suction limpets, snails, pycnogonids, possibly a clam or two and other biota into jar #2. This is a broad sample. Starttime=2058:50 Endtime=2108. [Rose]
R1014-HFS-0015	Mkr-113	45.92279	-129.98838	1524	32	21	32	Sep 04 2006	HFS filtered bag #10. Tmax=28.7°C Tavg=285.2°C T2=18°C. Vol=597ml. Endtime=2136. Lush biota area. In a tubeworm bush. [Butterfield]
R1014-HFS-0016	Mkr-113	45.92279	-129.98838	1524	31	21	39	Sep 04 2006	HFS unfilterd bag #14. Tmax=28.5°C Tavg=28.3°C T2=18°C. Vol=602ml. Endtime=2142. Same spot as previous sample. In tubeworm bush. [Butterfield]
R1014-HFS-0017	Mkr-113	45.92279	-129.98838	1524	31	21	44	Sep 04 2006	HFS sterivex filter #20. Tmax=28.5°C Tavg=27.5°C T2=17°C. Vol=2208ml. Endtime=2159:30. In the tubeworm bush. [Butterfield]
R1014-HFS-0018	El Guapo	45.92659	-129.97991	1509	119	22	34	Sep 04 2006	HFS filtered bag #11. Tmax=298.6°C Tavg=285°C T2=°C. Vol=329ml. Endtime=23:37. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Butterfield]
R1014-GAS-0019	El Guapo	45.92659	-129.97991	1509	119	23	36	Sep 04 2006	Gas tight bottle #7 - hydraulic line #1. Fired successfully. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Evans]
R1014-HFS-0020	El Guapo	45.92659	-129.97991	1509	119	22	36	Sep 04 2006	HFS unfiltered bag #13. Tmax=313.4°C Tavg=307.4°C T2=70°C. Vol=317ml. Endtime=23:40. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Butterfield]
R1014-GAS-0021	El Guapo	45.92659	-129.97991	1509	119	23	38	Sep 04 2006	Gas tight bottle #2 - hydraulic line #2. Fired successfully. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Evans]
R1014-HFS-0022	El Guapo	45.92659	-129.97991	1509	119	23	40	Sep 04 2006	HFS filtered piston #6. Tmax=336.5°C Tavg=319.2°C T2=70°C. Vol=619ml. Endtime=23:45. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Butterfield]
R1014-HFS-0023	El Guapo	45.92659	-129.97991	1509	120	23	46	Sep 04 2006	HFS filtered piston #5. Tmax=338.7°C Tavg=337.6°C T2=73°C. Vol=567ml. Endtime=23:46. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Butterfield]
R1014-SS-0024	Diva	45.92645	-129.97960	1525	282	00	44	Sep 05 2006	Suctioning blue mats into jar #3 with a 200 micron double mesh sieve. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Kouris]
R1014-Bio-0025	Diva	45.92645	-129.97960	1525	288	01	01	Sep 05 2006	Took a grab of hydrothermal sediment and rock with blue mat on it. Going in to the purse. (This position does not agree with the features on the AUV hi-res bathymetry. The features are offset to the east ~50m) [Kouris]

5.6 *ROPOS* DIVE LOGS

All dive log latitude/longitude positions are preliminary and uncorrected.

5.6.1 R1008 - Mothra Field (Endeavour)

R1008 Mothra Field, Endeavour Segment. [R1008 Bottom time: 8/26 0206 - 0600 (3 hrs 54 min)] Launched the ROV with HFS, 3 gas-tights, vent cover and MTR in purse. Landed east of Faulty Towers. Used Homer 25 to find RAS site. Photographed site, but did not have time for any sampling or measurements before recovering instrument. Placed temperature recorder and intake on top of the RAS and pulled pin. While recovery of the mooring was in progress, the ROV was able to do some video observations. Following RAS recovery, we took a suction and HFS sample at Notre Dame (~100m south of Faulty Towers). Then returned to the RAS site at The Tower, took 1 HFS sample at the intake spot and a second ~ 30 cm away. We moved straight up to the top of The Tower to attempt a high-temperature water sample. The setup was too difficult and we were unable to get a sample. Time ran out and we had to end the dive. Only 3 samples successfully collected. Notre Dame: 1 SS, 1 HFS. The Tower RAS site: 1 HFS. Recovered RAS at Faulty Towers.

Time	Z	Hdg	raw lat	raw long	R1008 Comments: Mothra Field (Endeavour)	FrGrab
23:42:56	1	214	48.31797	-123.85296	Start of the dive - entering the water.	
23:43:05	1	186	48.31797	-123.85296	ROPOS just entered the water.	R1008-001
23:45:35	1	159	48.31797	-123.85296	ROPOS in the water.	
23:48:48	18	249	48.31797	-123.85296	DVD decks with and without overlay are recording.	
23:50:16	32	316	47.92378	-129.10877	**The video overlay is: top row date time (UTC). 2nd row lat long. 3rd row: heading and depth.**	
23:57:21	68	310	47.92380	-129.10868	All the floats are attached to the cable - ROPOS is clear to dive.	
00:02:37	133	298	47.92384	-129.10882	The descent continues.	
00:14:39	408	148	47.92384	-129.10882	Still descending.	
01:22:36	1584	175	47.92394	-129.10857	Still descending.	
01:41:23	1929	189	47.92397	-129.10869	Getting a signal from homer #29.	
02:04:02	2256	161	47.92391	-129.10844	Just about at the bottom.	
02:05:34	2272	160	47.92397	-129.10841	We're 14 meters off the bottom and only 20 meters from the RAS according to the homer probe. Main objective of the dive is to recover the RAS - during daylight hours.	
02:06:38	2285	160	47.92420	-129.10842	We're on the bottom.	
02:06:47	2286	162	47.92420	-129.10805	At the bottom.	R1008-002
02:07:31	2287	159	47.92404	-129.10838	We're going to stop and pick up the sampler intake that has been hanging down during the descent.	
02:08:04	2289	156	47.92392	-129.10841	Stopped.	R1008-003
02:09:36	2288	157	47.92371	-129.10838	The intake is in the holster.	R1008-004
02:09:40	2289	157	47.92371	-129.10838	The intake is back in the holster. We're in business and on to the RAS that is right in front of us.	
02:11:32	2284	159	47.92410	-129.10825	Started the DVCam tapes.	
02:11:42	2283	161	47.92410	-129.10825	Moving to the next fluid sampler.	R1008-005
02:13:49	2284	219	47.92379	-129.10844	Still trying to work out the location of the homer.	
02:15:02	2282	26	47.92382	-129.10857	The Homer is 19m away and we can see the tower structure on the sonar.	
02:16:02	2280	334	47.92383	-129.10845	Moving to the next fluid sampler.	R1008-006
02:16:30	2281	319	47.92403	-129.10851		R1008-007
02:16:46	2279	318	47.92414	-129.10862	The RAS buoy is spotted. It looks to be in pretty good shape.	
02:16:52	2276	316	47.92414	-129.10862	RAS in view.	R1008-008
02:17:47	2278	337	47.92390	-129.10860	RAS.	R1008-009
02:18:03	2279	343	47.92399	-129.10862	Getting ready to release the RAS. Taking a DSC overview of it.	
02:19:59	2278	341	47.92407	-129.10861	RAS.	R1008-010
02:20:38	2281	348	47.92412	-129.10856	Getting some DSCs of the intake.	
02:21:00	2281	357	47.92608	-129.11163	Intake.	R1008-011
02:23:21	2281	351	47.92409	-129.10866	Intake.	R1008-012
02:23:30	2281	345	47.92404	-129.10863	Marker #32 for the tether on the mini temperature recorder.	
02:24:01	2281	339	47.92409	-129.10866	Intake.	R1008-013
02:24:30	2281	339	47.92413	-129.10871	Grabbing intake.	R1008-014
02:24:39	2281	347	47.92403	-129.10853	A small hot vent was seen in the background here.	
02:24:46	2281	352	47.92403	-129.10853	Intake grabbed.	R1008-015
02:25:04	2280	355	47.93224	-129.13231	Moving intake.	R1008-016
02:25:34	2280	304	47.92393	-129.10861	Dropped intake.	R1008-017
02:25:51	2281	311	47.92391	-129.10859	Going to grab intake again.	R1008-018
02:26:08	2282	329	47.92392	-129.10854	Grabbing intake.	R1008-019
02:26:23	2282	351	47.92404	-129.10873	Moving intake.	R1008-020
02:26:46	2280	314	47.92413	-129.10860	Intake looks fine and we are putting it in the top of the RAS.	

Time	Z	Hdg	raw lat	raw long	R1008 Comments: Mothra Field (Endeavour)	FrGrab
02:27:00	2280	301	47.92532	-129.11042	Getting intake in holster.	R1008-021
02:27:41	2280	302	47.92427	-129.10861	Intake safely stowed.	
02:28:04	2280	287	47.92427	-129.10861	Intake in holster.	R1008-022
02:28:09	2281	292	47.92427	-129.10861	Getting ready to release the pull-pin. The ship is moving into position to recover it when it reaches the surface.	
02:28:35	2281	308	47.92409	-129.10849	Bottom of RAS.	R1008-023
02:30:50	2280	332	47.92408	-129.10863	RAS.	R1008-024
02:31:05	2282	330	47.92408	-129.10863	Bottom of RAS.	R1008-025
02:31:40	2282	338	47.92408	-129.10863	Bottom of RAS.	R1008-026
02:33:59	2282	359	47.92399	-129.10859	Getting ready to release the RAS.	R1008-027
02:35:57	2282	358	47.92398	-129.10855	Next to the RAS.	R1008-028
02:36:48	2282	353	47.92399	-129.10877	RAS anchor.	R1008-029
02:37:30	2283	354	47.92414	-129.10853	Moving ROPOS to release the pin.	
02:38:38	2282	339	47.92408	-129.10858	Grabbing RAS rope.	R1008-030
02:39:13	2282	343	47.92408	-129.10858	RAS rope grabbed.	R1008-031
02:39:19	2282	344	47.92408	-129.10858	ROPOS has grabbed the anchor rope with the 7-function Magnum arm.	
02:39:44	2282	349	47.92418	-129.10852	Second grab.	R1008-032
02:40:59	2282	2	47.92354	-129.10864	Grabbing RAS rope.	R1008-033
02:41:34	2282	3	47.92730	-129.11115	Trying to position ROPOS to have access to the pull-pin with both arms.	
02:42:47	2282	11	47.92400	-129.10860	Grabbing RAS rope.	R1008-034
02:43:45	2281	10	47.92408	-129.10861	Trying to release the RAS.	R1008-035
02:44:54	2282	10	47.92404	-129.10847	Successful release of the RAS. It is heading to the surface.	
02:44:58	2281	12	47.92407	-129.10852	RAS released.	R1008-036
02:46:05	2271	308	47.92410	-129.10858	Hot Harold next to RAS emplacement.	R1008-037
03:11:16	2286	188	47.92287	-129.10818	We're just sitting here since we **released the RAS**. We've turned the DVCam off for now as we're in one place. Will just stay here until the RAS is recovered.	
03:17:04	2287	185	47.92274	-129.10838	We're sitting here and Raphael is zooming around looking at things. Possibly crinoids and soft corals.	
03:17:16	2287	185	47.92282	-129.10830	Macrofauna on extinct chimney.	R1008-038
03:19:59	2287	185	47.92278	-129.10822	Close-up of soft coral on extinct chimney.	R1008-039
03:20:06	2287	185	47.92272	-129.10809	The **RAS is at the surfac**e.	
03:22:14	2287	185	47.92273	-129.10822	Bacterial mat	R1008-040
03:23:25	2285	209	47.92277	-129.10815	Fallen structures with soft coral.	R1008-041
03:28:11	2281	222	47.92220	-129.10927	Sulfide chimney with venting at the top.	R1008-042
03:28:47	2282	232	47.92220	-129.10923	This sulfide is more than 20 meters tall. Hot water is pouring out of it. Very impressive.	
03:28:52	2281	233	47.92225	-129.10914	Chimlets at the top of the 20m structure.	R1008-043
03:30:52	2280	261	47.92240	-129.10902	Tubeworms etc. on the side of the structure.	R1008-044
03:31:50	2280	245	47.92211	-129.10942	This chimney is absolutely covered with biota. Palm worms; sulfide worms; limpets (perhaps) etc. etc.	
03:32:12	2280	244	47.92215	-129.10947	Close up of tubeworms and limpets on the side of the same structure.	R1008-045
03:34:03	2281	245	47.92219	-129.10931	Chimlets on side of structure - with diffuse flow surrounding them.	R1008-046
03:34:27	2281	239	47.93270	-129.13351	Started the DVCam tape again.	
03:38:52	2280	8	47.92217	-129.10924	We're still looking at this incredible sulfide. Taking several digitals of this structure.	
03:42:00	2280	135	47.92231	-129.10931	Jonathan wants a suction sample of limpets from the base of this huge sulfide structure.	
03:45:51	2294	134	47.92216	-129.10939	Base of same structure with tubeworms.	R1008-047
03:46:06	2295	137	47.92156	-129.10866	RAS came on board ~0340 UTC.	
03:48:40	2296	140	47.92217	-129.10924	Base of structure.	R1008-048
03:48:53	2295	151	47.92367	-129.11192	We're debating why the color seems to be washed out. Big Keith is messing with it.	
03:51:00	2293	151	47.92220	-129.10927	Taking lots of digital stills for Raphael.	
03:51:09	2293	159	47.92222	-129.10925	Base of structure.	R1008-049
03:53:06	2274	142	47.92220	-129.10931	We're maneuvering around the chimney. We're not going to get the limpet sample - at least that's what it looks like.... Dave just returned.	
03:54:30	2287	149	47.92208	-129.10924	Midway up the structure.	R1008-050
03:55:21	2294	142	47.92213	-129.10901	Dave is going to do fluid sampling here.	
03:56:10	2296	154	47.92223	-129.10914	We will leave the bottom at 11pm. We have about 2 hours of bottom time left.	
03:57:21	2292	149	47.92220	-129.10921	Dave doesn't recognize this exactly. ***Based on the offset*** it seems that it may be **"Notre Dame"** and it seems like a good name for it.	
03:59:30	2299	187	47.92224	-129.10916	We're going to suction this sulfide after all.	
03:59:51	2299	179	47.92224	-129.10917	Suction sample jar 1. 180 micron mesh. Get whatever are here - probably limpets, tubeworms, snails? Start 0402. Stop 0407. Suction at the base of this 20 meter high chimney. Notre Dame? **R1008-SS-0001 (Rose)**	
04:00:35	2299	179	47.92225	-129.10916	Preparing to get suction sample for Jonathan.	R1008-051

Time	Z	Hdg	raw lat	raw long	R1008 Comments: Mothra Field (Endeavour)	FrGrab
04:02:17	2299	179	47.92221	-129.10917	Preparing to sample.	R1008-052
04:03:13	2299	178	47.92219	-129.10921	Sampling	R1008-053
04:04:17	2299	178	47.92219	-129.10921	Sampling	R1008-054
04:05:30	2299	178	47.92218	-129.10917	Sampling	R1008-055
04:06:03	2299	178	47.92218	-129.10911	Suction sampling	R1008-056
04:06:46	2299	178	47.92218	-129.10911	The color was improved greatly after Big Keith messed with things.	
04:06:57	2299	176	47.92218	-129.10911	Jar filled with sample	R1008-057
04:07:54	2299	175	47.92218	-129.10910	The plan is to go to the top of this thing and sample some hot water. Transferring the digital stills now. Got lots of them of this structure we think is "Notre Dame".	
04:11:03	2282	217	47.92218	-129.10910	Looking for fluid sampling spot at the top of the structure we think are Notre Dame.	R1008-058
04:11:38	2281	207	47.92217	-129.10911	Looking for a sampling orifice. LOTS of intense flow here. Don't want to melt the front of the fluid sampler...	
04:12:00	2282	212	47.92218	-129.10910	Getting temperature reading off the 3-temp (65 deg C).	R1008-059
04:12:17	2282	214	47.92218	-129.10909	Measuring the temp here. Getting ready to grab the wand.	
04:14:53	2282	224	47.92221	-129.10912	Preparing to take fluid sample.	R1008-060
04:14:58	2282	224	47.92221	-129.10912	Got the wand. Heading for the sampling position now.	
04:15:16	2282	222	47.92222	-129.10912	Preparing to take fluid sample.	R1008-061
04:15:24	2282	220	47.92221	-129.10912	New sampling wand this year - held together with flanges and Dave thinks it won't break.	
04:15:50	2282	214	47.92221	-129.10910	22C right now. Maneuvering the wand and trying to find a good spot. Broke off a small beehive to get to the good flow.	
04:15:50	2282	214	47.92221	-129.10910	Getting temperature from fluid sampler.	R1008-062
04:16:37	2282	206	47.92220	-129.10911	Removed small piece - looking for hotter water.	R1008-063
04:17:58	2282	200	47.92222	-129.10913	Looking for a good temperature to sample.	R1008-064
04:18:01	2282	200	47.92222	-129.10913	Tmax=62. Then down to 5C. Huh? Trying to find the perfect spot.	
04:21:53	2282	195	47.92225	-129.10916	Looking for a better spot on this chimney to sample.	
04:23:00	2282	193	47.92224	-129.10916	Probing for a hotter temperature fluid.	R1008-065
04:25:03	2282	191	47.92223	-129.10912	We've found a better spot.	
04:25:41	2282	191	47.92222	-129.10913	HFS filtered bag#7. Start 0426:20. Stop 0430. Tmax=30.4 T2=16 Tavg=20.8 Vol=560ml. Notre Dame? **R1008-HFS-0002 (Butterfield)**	
04:25:44	2282	191	47.92222	-129.10914	Preparing to take fluid sample.	R1008-066
04:26:26	2282	189	47.92220	-129.10915	Sampling (#7).	R1008-067
04:30:28	2282	202	47.92220	-129.10914	Stopping fluid sample (#7).	R1008-068
04:31:19	2282	203	47.92220	-129.10915	Checking the guages and will move the intake and take another couple samples. Filter next for Andrew.	
04:33:23	2282	232	47.92220	-129.10913	We're heading back to where the RAS was deployed. It was at the base of the structure called **Hot Harold - which is one of the spires on the east face of the Faulty Towers complex.**	
04:42:06	2294	6	47.92331	-129.10894	Passing over a large broken down sulfide log.	
04:42:18	2294	6	47.92334	-129.10895	Passing over sulfide talus.	R1008-069
04:42:40	2295	6	47.92339	-129.10894	Passing over extinct sulfide chimneys - several have fallen over.	R1008-070
04:42:46	2295	6	47.92340	-129.10894	More extinct sulfide laying on the seafloor.	
04:47:08	2293	20	47.92385	-129.10895	Extinct fallen sulfides.	R1008-071
04:47:39	2290	89	47.92391	-129.10881	Traveling toward the next sampling site. Looking like we're at the edge of Faulty towers. We're looking at the pull pin for the RAS so we're very near the sampling site.	
04:47:40	2290	89	47.92391	-129.10880	Hydrothermal sulfides.	R1008-072
04:48:06	2284	91	47.92390	-129.10861	Pin at the edge of **Faulty Towers**.	R1008-073
04:49:05	2279	356	47.92398	-129.10851	What is that thing?	
04:49:10	2279	355	47.92398	-129.10852	Pull pin from RAS.	R1008-074
04:49:18	2279	350	47.92399	-129.10854	We're there. Faulty Towers is a massive structure with lots of spires.	
04:50:26	2280	333	47.92402	-129.10856	Dave says the spot the RAS was in was very low flow in the crack right here.	
04:50:44	2281	341	47.92402	-129.10858	Looking for RAS sampling site to get fluid and DNA samples.	R1008-075
04:50:54	2281	338	47.92403	-129.10858	Not much coming out of there.	
04:51:23	2282	349	47.92402	-129.10858	We will take a sample here where there is hardly any flow - but want to do that because it was the RAS site.	
04:52:01	2282	339	47.92403	-129.10856	We're looking at the spot where the sampler intake was and we will poke around - take a water sample and a filter. Then we will get some hotter water from here.	
04:52:05	2282	342	47.92403	-129.10856	This is where the RAS sampler intake was located.	R1008-076
04:53:36	2282	327	47.92403	-129.10856	5 or 6 digitals here.	
04:54:26	2282	324	47.92403	-129.10856	We are probing for the temperature at the RAS intake site.	R1008-077
04:54:50	2282	319	47.92404	-129.10855	Taking some temps here and not getting much. 2 or 3 C here.	
04:56:46	2282	316	47.92403	-129.10854	We're going to take a quick sample here now and then we will move to some hotter water in the background.	

Time	Z	Hdg	raw lat	raw long	R1008 Comments: Mothra Field (Endeavour)	FrGrab
04:56:55	2282	316	47.92403	-129.10854	Look at the little fish on the right bottom corner!	R1008-078
04:57:13	2282	316	47.92402	-129.10855	HFS unfiltered bag#12. Tmax=3.3 Tavg=2.7. T2=2. Vol=505ml. Hot Harold at Faulty Towers. 2005 RAS intake site. **R1008-HFS-0003 (Butterfield)**	
04:58:45	2282	314	47.92401	-129.10856	Sampling fluid from the 2005 Hot Harold intake site (3 deg-C).	R1008-079
05:02:31	2282	310	47.92403	-129.10853	The fluid sample is complete.	R1008-080
05:03:26	2282	305	47.92404	-129.10853	Going to look for some hotter water in the vicinity.	
05:03:39	2282	298	47.92405	-129.10853	We are looking for warmer temperature to sample fluids and microbes.	R1008-081
05:04:46	2282	290	47.92404	-129.10854	We are probing the temperature of a warmer diffuse site.	R1008-082
05:06:00	2282	290	47.92405	-129.10853	Looks like there is some good flow here.	
05:06:26	2282	290	47.92406	-129.10852	HFS filtered bag#9. Temp~60C. Tmax=62.2 Tavg=58.9. Vol=550ml. Hot Harold/Faulty Towers. **R1008-HFS-0004 (Butterfield)**	
05:06:27	2282	290	47.92406	-129.10852	We are preparing to take another fluid sample (filtered bag #9).	R1008-083
05:07:08	2282	290	47.92406	-129.10851	We are sampling ~60 deg-C fluid from this site.	R1008-084
05:11:15	2282	290	47.92404	-129.10853	HFS Sterivex filter#15. Start=0512. Stop=0513:23. Start2=0515:20 Stop2=0518:30. Start3=0522:30 Stop3=0528:59 Tmax=76.4 Tavg=53.7 T2=45. Vol=1329 ml Lots of repositioning going on. Intake was a bit clogged. Hot Harold/Faulty Towers. **R1008-HFS-0005 (Butterfield)**	
05:12:16	2282	290	47.92405	-129.10853	We are sampling sterivex filter #15 from the same site as the previous fluid sample.	R1008-085
05:13:22	2282	290	47.92405	-129.10852	We have stopped sampling to regain sampler position.	R1008-086
05:15:29	2282	290	47.92406	-129.10852	We have resumed sampling sterivex #15.	R1008-087
05:18:40	2282	296	47.92406	-129.10853	We had to stop sampling again to reposition.	R1008-088
05:21:13	2282	292	47.92405	-129.10856	We have found a hotter temperature and will continue to sample sterivex #15.	R1008-089
05:21:52	2282	293	47.92406	-129.10855	We are probing the temperature of this new temperature fluid.	R1008-090
05:22:40	2282	293	47.92406	-129.10856	We have resumed sampling.	R1008-091
05:29:08	2282	293	47.92405	-129.10847	We have stopped sampling.	R1008-092
05:31:01	2281	284	47.92406	-129.10848	Looks like blue mat.	R1008-093
05:31:45	2280	265	47.92406	-129.10849	Looks like some blue mat here.	
05:32:05	2280	294	47.92404	-129.10850	We're looking for another sampling site on this structure.	
05:33:16	2277	305	47.92403	-129.10855	Quite an incredible overhang here.	
05:33:58	2271	300	47.92403	-129.10853	Smoke here at the top of this edifice.	
05:34:40	2266	298	47.92405	-129.10858	The top of this is ~20 meters above the seafloor.	
05:34:50	2266	294	47.92405	-129.10858	We are at the top of the structure - ~20m off the seafloor	R1008-094
05:36:04	2266	282	47.92405	-129.10862	Beautiful beehive here.	
05:36:23	2266	278	47.92405	-129.10862	We are getting in position to sample the hot fluid coming out of the top of Hot Harold.	R1008-095
05:38:30	2266	288	47.92406	-129.10861	We are preparing to sample this vent.	R1008-096
05:44:17	2265	211	47.92413	-129.10859	We have had to reposition ROPOS in order to stabilize enough to sample.	R1008-097
05:47:29	2265	256	47.92408	-129.10857	We just knocked over the top of this chimney. That's not good.....	
05:48:29	2266	276	47.92406	-129.10860	We have accidentally knocked off the top of the structure.	R1008-098
05:48:57	2266	253	47.92408	-129.10861	We're trying hard to get a water sample here.	
05:49:11	2266	258	47.92407	-129.10860	The top was knocked off of the chimney.	R1008-099
05:49:42	2266	247	47.92407	-129.10861	Worms are flying everywhere. Looks like a bit is missing from the top.	
05:51:24	2267	223	47.92409	-129.10862	OK we're still trying to set up here. The top broke off so there is a place for the intake now. Taking a temp.	
05:51:56	2267	233	47.92410	-129.10861	We are preparing to sample.	R1008-100
05:54:50	2267	238	47.92411	-129.10859	We are probing the temperature of the fluid coming out of the opened chimney.	R1008-101
05:55:03	2267	239	47.92411	-129.10859	Measuring the temp here at the top of this chimney. Looks like it's over 75 and climbing. 80..	
05:55:48	2267	248	47.92409	-129.10859	Moving the intake around.	
05:57:26	2267	240	47.92407	-129.10861	One more try. Seem to be having trouble keeping the intake in the orifice. Jumping about.	
05:58:38	2267	229	47.92410	-129.10855	Temp of 104C for a few seconds but have to back off now. Nothing to grab on to and a bit out of reach. We won't get a sample. We've run out of time.	
05:59:35	2256	328	47.92415	-129.10850	We're bringing up the sub now. Moving the DSCs.	
06:01:29	2186	179	47.92426	-129.10851	Coming up.	
07:23:05	69	136	47.92422	-129.10833	Floats are on the surface.	
07:36:06	8	135	47.92427	-129.10835	ROPOS is at the surface.	
07:37:03	3	126	47.92423	-129.10827	ROPOS is secured.	
07:39:54	3	261	47.92423	-129.10821	ROPOS is on deck.	

5.6.2 R1009 - Main Endeavour Field (Endeavour)

R1009 Main Endeavour Field, Endeavour Segment. [R1009 Bottom time: 8/26 2001 - 8/27 0853 (12 hrs 52 min)] Found the RAS immediately. Drove to SW Hulk site and documented the condition of 2005 RAS #17, stowed temperature sensor/intake. DSC survey. It was covered in furry microbial mat. Pulled pin and recovered RAS. Took video while waiting and ended up on West side of vent field. Crossed back over to RAS mooring. Released drop anchor and moved it to SW Hulk around S side of Crypto and deployed it for the year. Drove to Dudley, took diffuse and high-T samples and sulfide chimney sample in purse. Drove to S/M, took diffuse sample in basalt near original RAS/2000 observatory site. Attempted high-T sample but not successful. Moved to Easter Island, took last water sample and a DNA filter in diffuse vent. Some video survey. Took small chimney sample into sed/larval trap. Recovered sediment/larval trap for UVic and came to surface. Trap and chimney sample lost at 40m depth during recovery. Location noted. All HFS water samples used. 27 samples total. 25 retrieved at surface. MEF: 1 SS of sed. SW Hulk: 8 HFS, 1 gas. Dudley: 5 HFS, 1 gas, 1 rock. S&M: 3 HFS. Easter Island: 3 HFS, 2 SS, 1 rock, 1 sedtrap.

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
17:47:27	3	93	47.92422	-129.10823	ROPOS is ready for launch.	
17:53:23	3	93	47.92422	-129.10823	ROPOS going in the water.	R1009-001
17:59:08	3	93	47.92422	-129.10823	ROPOS is in the water and the cable floats are being added.	
18:09:44	3	93	47.92422	-129.10823	Depth does not seem to be updating in the log. Will try to work things out.	
18:10:10	3	93	47.92422	-129.10823	The overlay data seems to be showing the depth correctly.	
18:13:13	105	180	47.95025	-129.09580	ROPOS is descending.	
18:14:37	124	298	47.95022	-129.09580	The logging information all appears to be correct now. Descent is progressing.	
18:42:42	670	177	47.95004	-129.09603	Still descending.	
19:52:03	2078	188	47.95014	-129.09580	We're about 30 meters off the bottom.	
20:01:31	2203	190	47.95035	-129.09576	The **RAS is ahead of us**.	
20:01:31	2203	190	47.95035	-129.09576	We have reached the bottom and came down right on the RAS that was dropped from the ship earlier today.	R1009-002
20:01:53	2209	193	47.95036	-129.09577	There's the bottom. We're looking at the RAS anchor now.	
20:02:23	2212	189	47.95032	-129.09579	The RAS ended up on the edge of a fissure.	R1009-003
20:02:40	2213	197	47.95032	-129.09578	It landed very close to a fissure. Close call but all is well.	
20:03:13	2215	193	47.95029	-129.09579	This is the RAS drop site.	R1009-004
20:04:53	2215	186	47.95028	-129.09578	The anchor looks fine here. We can now head straight for the SW Hulk site where we are going to locate the other instrument (deployed last year).	
20:07:40	2215	186	47.95029	-129.09579	The DVCam and DVDs are going. DVDs have been on since the surface.	
20:09:12	2216	186	47.95030	-129.09579	We're going to flush the suction system and then take a suction sample of the sediments hoping to get glass particles for Dave Clague.	
20:10:44	2216	186	47.95030	-129.09577	We're looking for volcanic glass samples in the seds.	
20:11:02	2215	186	47.95030	-129.09577	Suction sample sediment into jar #7 (1mm mesh). Trying to get volcanic glass pieces that are (hopefully) in the sediments. Start 2013. Relocated slightly at 2022. Stop 2031. Z=2215m. Main Endeavour Field (MEF). **R1009-SS-0001 (Clague)**	
20:13:16	2216	186	47.95028	-129.09578	We are taking a sediment suction sample.	R1009-005
20:14:22	2216	186	47.95029	-129.09576	We are in the process of taking the suction sample of the sediments hoping to get small pieces of volcanic glass.	R1009-006
20:15:46	2216	186	47.95029	-129.09576	Jar #7 after suction sampling.	R1009-007
20:17:49	2216	186	47.95029	-129.09577	We have returned to suction some more sediment from the same spot.	R1009-008
20:25:40	2216	176	47.95028	-129.09578	We are sampling a new spot.	R1009-009
20:27:04	2216	177	47.95028	-129.09578	We are still suction sampling sediment from the second spot.	R1009-010
20:29:04	2216	176	47.95026	-129.09581	Jar #7 after the second session of suction sampling.	R1009-011
20:29:58	2216	176	47.95027	-129.09580	We are flushing the suction sampler.	R1009-012
20:36:04	2213	186	47.95030	-129.09581	Passing by the **2006 RAS destined for SW Hulk** on our way towards Hulk.	R1009-013
20:36:50	2212	231	47.95028	-129.09571	We're moving towards the RAS site at Hulk. The ship is moving SW. We're going to stay near the bottom and come around the south side of some structures and then head NE toward Hulk.	
20:39:26	2220	267	47.95025	-129.09642	We are passing over a metal bucket.	R1009-014
20:41:02	2215	264	47.95028	-129.09670	We have reached a low-lying sulfide structure which looks active.	R1009-015
20:41:09	2214	263	47.95027	-129.09671	We're looking at the outskirts of the Hulk area. It's a low-lying sulfide structure. This could be Crypto or Hulk. There's a marker.	
20:42:17	2217	265	47.95024	-129.09670	We're looking at marker T4. An old RAS marker. There's marker 85 (very old). We are going to pick up T2 marker. There may be a temp probe on it.	

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
20:42:26	2217	264	47.95023	-129.09671	We have reached a triangle marker used in a previous RAS deployment.	R1009-016
20:44:17	2219	254	47.95023	-129.09673	This was the sight of the 2004 Western Flyer short term RAS deployment. T2 is connected to a weight.	
20:44:39	2219	256	47.95023	-129.09673	We have found one of the sites used in the 2003 short-term RAS deployment.	R1009-017
20:49:19	2217	256	47.95015	-129.09671	We're looking around.	
20:53:26	2207	25	47.95000	-129.09697	We're coming up in the water to get a better look at these structures. This is a black smoker here. It's been marked as **Crypto Smoker** on the navigation.	
20:54:59	2209	41	47.95013	-129.09689	We're looking around for the RAS and just surveying the area.	
20:55:01	2209	41	47.95013	-129.09689	We are passing by Crypto and heading toward Hulk.	R1009-018
20:55:23	2208	27	47.95016	-129.09690	Looking at **Marker C for Crypto**. Cr marker.	
20:55:32	2208	31	47.95015	-129.09693	We have reached the Crypto marker.	R1009-019
20:56:16	2211	27	47.95020	-129.09698	We're going to keep going N/NE.	
20:56:43	2208	26	47.95025	-129.09704	There's the RAS straight ahead.	
20:56:45	2208	24	47.95026	-129.09704	We have reached the 2005 deployment site of the RAS (#17).	R1009-020
20:57:16	2206	25	47.95032	-129.09703	The RAS is covered with biology and probably corrosion. There's a little smoker going here now that wasn't here when it was deployed.	
20:57:44	2209	24	47.95037	-129.09700	The 2005 RAS anchor/intake area.	R1009-021
20:58:14	2210	27	47.95037	-129.09698	The plan is to take a series of DSCs here to get a good look at it before we recover the RAS.	
20:58:22	2210	27	47.95038	-129.09697	The 2005 RAS anchor/intake area.	R1009-022
20:59:46	2207	290	47.95041	-129.09685	Looking at the structure. Holes were drilled into the structure ahead.	
21:00:31	2209	266	47.95039	-129.09690	The 2005 RAS anchor/intake area.	R1009-023
21:00:39	2209	273	47.95038	-129.09690	We're going to go around in a semi-circle here and take as many DSCs as possible of the RAS before recovery. **This RAS is RAS 17 at SW Hulk (deployed in 2005).**	
21:01:58	2210	317	47.95034	-129.09691	We're moving around the RAS getting images before we release it.	R1009-024
21:02:13	2210	343	47.95034	-129.09694	We're moving around the RAS getting images before we release it.	R1009-025
21:04:31	2209	84	47.95037	-129.09699	We will first pick up the temperature probe (recorder) and put it up on top of the RAS.	
21:05:12	2209	331	47.95035	-129.09692	We're moving around the RAS getting images before we release it.	R1009-026
21:05:26	2209	294	47.95035	-129.09691	Filamentous bacterial mat covers the RAS frame and everything else.	R1009-027
21:06:00	2210	250	47.95039	-129.09690	Grabbing the intake/temp probe.	R1009-028
21:06:26	2210	252	47.95039	-129.09691	We're going to pull the intake and temp probe (they're tied together) and will set it on the RAS.	
21:07:50	2209	274	47.95041	-129.09693	We are approaching the RAS to remove the intake.	R1009-029
21:09:42	2211	279	47.95039	-129.09694		R1009-030
21:11:31	2212	294	47.95035	-129.09692	Grabbing the intake. It's quite sturdy and holding together well. Taking a digital of the mat/bio covered frame.	
21:11:43	2209	292	47.95036	-129.09690	We have recovered the intake.	R1009-031
21:13:03	2206	292	47.95038	-129.09696	It's totally covered (furry) with microbial mat.	
21:13:22	2206	294	47.95037	-129.09693	We are preparing to put the intake inside the cage for recovery.	R1009-032
21:14:11	2208	290	47.95037	-129.09694	It's the "Galdalf RAS".	
21:14:48	2209	290	47.95037	-129.09690	Fix on the RAS 17 at SW Hulk deployed in 2005: 47°57.0225' 129°5.8180'.	
21:15:44	2208	286	47.95037	-129.09688	We are preparing to pull the pin and send the instrument to the surface.	R1009-033
21:16:58	2207	286	47.95035	-129.09694	The base of the RAS covered with white filamentous bacteria.	R1009-034
21:17:05	2206	285	47.95035	-129.09693	We're going to release the RAS. The ship will need to move SW.	
21:19:52	2209	278	47.95034	-129.09690	We're preparing to grab the rope then pull the pin.	
21:21:36	2208	129	47.95039	-129.09704	The base of the RAS just before release.	R1009-035
21:24:19	2210	110	47.95039	-129.09701	The cord is covered with limpets.	R1009-036
21:24:45	2210	111	47.95036	-129.09690	Got the cord.	
21:24:58	2210	112	47.95041	-129.09704	It took 35 minutes to get to the surface yesterday. It's on its way right now.	
21:25:52	2206	19	47.95037	-129.09697	**RAS 17 at SW Hulk - deployed in 2005 - is heading toward the surface.**	
21:36:30	2199	176	47.94922	-129.09679	We're sitting here until the RAS is recovered. No bottom in sight now.	
21:59:42	2222	331	47.94842	-129.09690	Super de-duper flat-screen monitor set up for logging!!	
22:01:37	2218	332	47.94891	-129.09731	We're following the boat as they go to get the RAS.	

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
22:15:33	2134	282	47.95092	-129.10044	Crinoid on the bottom.	R1009-037
22:16:01	2134	282	47.95092	-129.10044	Sponges all over this blocky lava.	R1009-038
22:16:19	2134	281	47.95092	-129.10044	Holothurian on blocky lava.	R1009-039
22:19:26	2135	279	47.95092	-129.10044	That's one fuzzy starfish!	
22:19:28	2134	279	47.95092	-129.10044	That's a very unusual starfish.	R1009-040
22:19:38	2135	279	47.95092	-129.10044	That's a very unusual starfish.	R1009-041
22:24:14	2135	258	47.95088	-129.10046	Sponges on pillow talus.	R1009-042
22:27:45	2134	260	47.95091	-129.10051	Little shrimp on the bottom of pillow talus.	R1009-043
22:27:51	2134	260	47.95091	-129.10050	We're just looking around here in this non-venting area. Looking at a shrimp now in the area of blocky pillow talus.	
22:31:29	2129	275	47.95085	-129.10056	The plan is to travel over to where we dropped the new RAS (2006 SW Hulk RAS) so that we can deploy it. 275 meters away at 103°.	
22:35:34	2139	112	47.95091	-129.10040	We're on a big talus slope. Dave Caress is doing the commentary now.	
22:36:14	2142	104	47.95088	-129.10028	Lots of sediments coming down - produced by these chimneys?	
22:37:10	2155	101	47.95082	-129.09998	Questions about whether or not anybody has worked on the non-vent fauna in this area.	
22:37:49	2159	99	47.95081	-129.09993	We're heading east to pick up the RAS to deploy it.	
22:38:38	2167	101	47.95078	-129.09975	This is some type of a starfish. Don't know for sure what it is.	
22:38:54	2165	104	47.95079	-129.09976	Sea star (?) on the way to the other RAS deployment site.	R1009-044
22:43:40	2192	88	47.95074	-129.09881	Lobate flows - some are collapsed. There's a talus slope coming up.	
22:45:15	2199	91	47.95072	-129.09850	Heavily sedimented lobate flows.	R1009-045
22:48:40	2199	86	47.95074	-129.09814	This looks like a sheet flow.	R1009-046
22:52:57	2199	84	47.95071	-129.09769	Passing over lobate flows.	
22:53:02	2198	83	47.95071	-129.09771	Shattered lobate flows and edge of collapse.	R1009-047
22:55:07	2201	102	47.95057	-129.09713	More sheet flows. We are approaching vents again.	
22:55:28	2200	102	47.95056	-129.09705	Bottom of vent structure.	R1009-048
22:57:25	2181	89	47.95061	-129.09658	Still heading back towards the RAS that was dropped this morning.	
23:01:02	2213	130	47.95048	-129.09604	Lobate flows and a large fissure. Still transiting to RAS.	
23:02:10	2214	149	47.95038	-129.09591	Fissure truncating lobate flows.	R1009-049
23:02:11	2214	149	47.95038	-129.09591	We are passing over the fissure again. The RAS is just ahead **(2006 SW Hulk RAS)**.	
23:02:54	2214	141	47.95035	-129.09593	RAS at the point where it was deployed this morning.	R1009-050
23:05:28	2216	180	47.95035	-129.09580	Discussing which part of the RAS anchor to remove for deployment.	
23:05:30	2216	185	47.95035	-129.09579	Anchor for RAS.	R1009-051
23:07:03	2216	182	47.95034	-129.09579	We are going to pick up part of the anchor to see the pin better.	
23:08:33	2216	180	47.95031	-129.09586	Pulling the pin to release the lower drop weight from the instrument anchor.	
23:09:29	2216	182	47.95031	-129.09586	Releasing the drop weight from the RAS anchor.	R1009-052
23:10:17	2216	160	47.95033	-129.09586	Pulled the pin.	
23:12:32	2213	175	47.95032	-129.09581	Picking up the RAS by the anchor to move it to the deployment site.	
23:13:51	2211	181	47.95045	-129.09587	Discussing which route to take to the deployment site.	
23:14:56	2213	202	47.95031	-129.09588	Heading south southwest (210) and we crossed over the large fissure again	
23:17:15	2217	210	47.94996	-129.09637	Passing over what may be a pressure ridge.	
23:18:20	2218	246	47.94991	-129.09640	The area is very heavily sedimented. We can barely see the tops of the pillows.	
23:20:13	2217	245	47.95001	-129.09653	Something on the bottom. It looks like a dredge.	
23:21:02	2220	253	47.95001	-129.09655	Tripod base for some instrument no longer here?	R1009-053
23:21:05	2220	250	47.95002	-129.09655	Looks like it is a tripod base for an instrument. It is not a dredge.	
23:21:58	2221	246	47.95002	-129.09664	Fresh pillows on top of the heavy sediment.	
23:22:15	2219	242	47.95003	-129.09666	Pillow flow over sediment.	R1009-054
23:23:21	2218	302	47.94991	-129.09675	Sheet flow broken open with a crab standing watch.	R1009-055
23:23:23	2218	304	47.94991	-129.09676	Coming up on the edge of a cracked and broken sheet flow.	
23:24:13	2215	315	47.94993	-129.09690	Talus and a large clump of tubeworms coming up a steep fissure face. Still heading to the RAS deployment site.	
23:24:26	2216	343	47.94995	-129.09693	Tube worms on fissure-truncated lava flow.	R1009-056
23:25:51	2210	42	47.95014	-129.09688	Large covering of tubeworms and some blue mat maybe. This is **Crypto**.	

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
23:25:56	2209	44	47.95014	-129.09688	Tube worms and blue mat.	R1009-057
23:26:20	2207	61	47.95019	-129.09692	We found the "CR" marker. Lots of venting and biota.	
23:26:24	2207	55	47.95020	-129.09692	Cr marker on Crypto.	R1009-058
23:27:04	2208	46	47.95027	-129.09699	Diffuse venting at Crypto.	R1009-059
23:27:48	2211	6	47.95024	-129.09698	Continuing north on our way back to Hulk.	
23:29:13	2210	348	47.95031	-129.09700	**T4 marker and small black smoker at Hulk.**	R1009-060
23:29:14	2210	348	47.95032	-129.09700	Found marker T4 at Hulk. Looking at the area to decide on best placement for the RAS.	
23:30:36	2209	349	47.95034	-129.09696	Going to set the RAS down to the NW while we do some fluid sampling in the area.	
23:31:51	2207	353	47.95039	-129.09699	This is the site called **SW Hulk RAS**.	
23:32:41	2207	319	47.95036	-129.09701	Jumbled sheet flow near SW Hulk RAS.	R1009-061
23:33:14	2207	288	47.95036	-129.09705	Large area of jumbled sheet flow to the west of Hulk marker.	
23:33:27	2208	293	47.95035	-129.09705	Jumbled sheet flow near SW Hulk RAS.	R1009-062
23:34:14	2208	297	47.95034	-129.09706	Setting down the RAS anchor in this jumbled flow.	
23:35:51	2204	299	47.95029	-129.09694	Going back to the SE to the T4 marker.	
23:38:10	2207	331	47.95030	-129.09687	T4 marker is back in sight.	
23:38:50	2209	311	47.95038	-129.09688	We will do some low temperature sampling first before sampling the smoker the RAS will be deployed in.	
23:42:32	2208	173	47.95045	-129.09695	Looking around for low temperature sites to sample.	
23:43:51	2210	180	47.95046	-129.09694	Tubeworms and small black smoker at marker T4.	R1009-063
23:45:22	2210	179	47.95046	-129.09694	Dave and Andrew are discussing sampling strategies.	
23:48:28	2210	174	47.95042	-129.09698	Picking up the HFS sample probe.	
23:52:27	2210	178	47.95038	-129.09697	HFS probe in an area of diffuse venting. Monitoring temperature.	
23:52:40	2210	178	47.95038	-129.09697	Reading temperatures; 43°C.	R1009-064
23:53:05	2210	178	47.95036	-129.09697	Reading temperatures; tubeworm plumes are visible.	R1009-065
23:53:50	2210	179	47.95036	-129.09699	Temperature max in this first place was 43 degrees.	
23:54:02	2210	179	47.95036	-129.09699	Reading temperatures.	R1009-066
23:54:37	2210	179	47.95041	-129.09700	Temp is 9°C.	R1009-067
23:54:44	2210	179	47.95041	-129.09700	We will take a temperature survey along this venting crack.	
23:55:51	2210	179	47.95037	-129.09694	Temperature is 27°C.	R1009-068
23:56:24	2210	179	47.95038	-129.09693	Transect of temperature is moving to the left along the crack.	
23:56:44	2210	179	47.95039	-129.09694	Temperature is 7°C.	R1009-069
23:58:01	2210	179	47.95040	-129.09694	Reading temperature; 16°C; Reddish worm tubes nearby.	R1009-070
23:59:43	2210	179	47.95040	-129.09696	Still continuing the temperature survey.	
0:01:40	2210	179	47.95040	-129.09691	Temperature is 25.5°C; Alvinellid and vestimeniferan worms.	R1009-071
0:04:28	2210	179	47.95040	-129.09691	HFS filtered bag #7. Tmax=25.1 Tavg=21.9 T2=14 Vol=667mls Z=2210. Sampling in crack where we did the temperature survey. SW Hulk. **R1009-HFS-0002 (Butterfield)**	
0:04:32	2210	179	47.95040	-129.09691	Fluid sampling at SW Hulk; HFS bag #7	R1009-072
0:11:26	2210	179	47.95041	-129.09687	HFS unfiltered bag #12. Tmax=26.2 Tavg=17.9 T2=15.5 Vol=671mls Z=2210. Actual start time 00:16. Temp dropped during sampling. Intake repositioned while still pumping. Same location as previous water sample at SW Hulk. **R1009-HFS-0003 (Butterfield)**	
0:18:36	2210	178	47.95040	-129.09695	Repositioned during sample bag #12.	R1009-073
0:21:29	2210	178	47.95040	-129.09696	HFS Sterivex filter #15. Tmax=28.9 Tavg=26.3 T2=17 Vol=1766mls Z=2210. Temperature was falling off a bit at the end of sampling. SW Hulk. **R1009-HFS-0004 (Butterfield)**	
0:32:22	2210	177	47.95039	-129.09693	HFS Sterivex filter #15.	R1009-074
0:36:44	2210	180	47.95042	-129.09706	Repositioning for the next round of sampling. Vehicle was getting pulled a bit.	
0:37:27	2210	188	47.95042	-129.09704	The crack we were just sampling.	R1009-075
0:39:45	2210	184	47.95009	-129.09663	Repositioned again. Checking for a stable temperature.	
0:40:33	2210	184	47.95006	-129.09659	Temp is low here. Want to find where it was 45 degrees.	
0:42:17	2210	184	47.95012	-129.09678	Poking around trying to find another sampling spot.	
0:44:18	2210	184	47.94993	-129.09668	Setting up the RAS sampling cone to get a T0 for the experiment.	
0:44:27	2210	184	47.94993	-129.09668	This is the general vicinity where Andrew will be sampling.	R1009-076

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
0:48:39	2210	180	47.94987	-129.09679	The sample cone has been pulled and is being placed over the flow.	
0:49:28	2210	180	47.94987	-129.09681	The cone is the intake for the RAS 2006 SW-Hulk deployment.	
0:49:37	2210	180	47.94987	-129.09681	The cone for the 2006 SW HULK RAS.	R1009-077
0:51:03	2210	180	47.95064	-129.09704	Top view of the 2006 SW HULK RAS.	R1009-078
0:53:01	2210	182	47.95053	-129.09706	The cone is successfully in place.	
0:54:06	2210	182	47.95053	-129.09705	Inserting sampling wand over cone.	R1009-079
0:55:06	2210	182	47.95037	-129.09684	The cone looks pretty well sealed into the worm mat. The temperature is slowly rising. Currently it is 20C.	
0:56:55	2210	182	47.95039	-129.09681	Picking up the MTR temperature recorder.	
0:58:36	2210	182	47.95046	-129.09704	It is MTR temperature recorder number 3005 and is going to be put in RAS cone.	
1:01:52	2210	181	47.95047	-129.09671	Put down the MTR for a moment while we stow the HFS intake.	
1:06:27	2210	181	47.95016	-129.09639	Having trouble holstering the HFS probe.	
1:06:49	2210	180	47.95015	-129.09636	Preparing to sample at T4 SW Hulk.	R1009-080
1:07:24	2210	180	47.95013	-129.09632	HFS intake is stowed.	
1:08:26	2210	181	47.95068	-129.09719	Picked up the MTR again and repositioning to place it in the vent cover.	
1:09:46	2209	183	47.95039	-129.09680	Sampling site; SW Hulk.	R1009-081
1:10:13	2209	181	47.95045	-129.09685	MTR and vent cover.	R1009-082
1:12:38	2210	181	47.95111	-129.09744	**Inserting MTR #3005 into vent cover at SW Hulk.**	R1009-083
1:12:48	2209	181	47.95117	-129.09749	MTR 3005 is in position in the vent cover and we will take a fluid sample in one of the other holes in the cover.	
1:14:28	2209	181	47.95027	-129.09660	MTR in vent cover at SW Hulk.	R1009-084
1:15:10	2209	181	47.95042	-129.09715	Inserting fluid sampler into vent cover.	R1009-085
1:15:33	2209	181	47.95043	-129.09725	Deciding which hole in the cover to sample. Temperature in both is about 20 degrees.	
1:16:12	2209	181	47.95038	-129.09679	Inserting water sampler into other hole of vent cover.	R1009-086
1:19:28	2210	181	47.95007	-129.09657	Moving the intake back to the first hole again.	
1:22:40	2209	181	47.95045	-129.09684	Checking stability of temperatures in and around the cover to determine where to deploy the RAS intake.	
1:26:10	2209	181	47.95033	-129.09667	Gastropods and tubeworms at SW Hulk sampling site.	R1009-087
1:29:21	2209	181	47.95033	-129.09667	Still trying to locate the best location for sampling. Looks like it will be in the farther hole near the top of the opening.	
1:30:39	2209	181	47.95033	-129.09667	HFS filtered bag #8. Tmax=32 Tavg=28.9 T2=19 Vol=591mls Z=2209. Actual start 01:31. Sampling in the vent cover oriface where the RAS will be deployed. SW Hulk Mkr-T4. **R1009-HFS-0005 (Butterfield)**	
1:33:01	2209	181	47.95033	-129.09667	Taking HFS filtered bag #8; MTR in foreground.	R1009-088
1:35:14	2209	181	47.95033	-129.09667	Gastropod with siphon tube and scaleworm.	R1009-089
1:37:48	2209	181	47.95033	-129.09667	HFS unfiltered bag #13. Tmax=32.8 Tavg=31.7 T2=20 Vol=593mls Z=2209. In vent cover where RAS will be deployed. SW Hulk Mkr-T4. **R1009-HFS-0006 (Butterfield)**	
1:38:06	2209	181	47.95033	-129.09667	Testing color.	R1009-090
1:42:11	2209	181	47.95033	-129.09667	Tube worms and gastropods.	R1009-091
1:42:39	2209	181	47.95033	-129.09667	HFS Sterivex filter #16. Tmax=32.8 Tavg=31.4 T2=19.5 Vol=2005mls Z=2209. Sampling in vent cover where RAS will be deployed. SW Hulk Mkr-T4. **R1009-HFS-0007 (Butterfield)**	
1:43:16	2209	181	47.95033	-129.09667	Gastropods and scaleworm and pycnogonids.	R1009-092
1:44:32	2209	181	47.95033	-129.09667	Vent fish.	R1009-093
1:46:30	2209	181	47.95033	-129.09667	Picture of sulfide and tube worms.	R1009-094
1:50:18	2209	181	47.95033	-129.09667	Overview of tubeworms and limpets near the vent.	R1009-095
1:51:36	2209	181	47.95033	-129.09667	A vent fish among the tubeworms.	R1009-096
1:53:30	2209	181	47.95033	-129.09667	Close up view of gastropod and tubeworms.	R1009-097
1:54:49	2209	181	47.95033	-129.09667	Tubeworms distorted due to shimmering water from the vent.	R1009-098
1:59:47	2209	181	47.95033	-129.09667	Done fluid sampling in the vent cover. Moving to the small smoker just 2 meters to the east of the vent cover for more fluid sampling.	
2:01:30	2209	81	47.95030	-129.09704	Placing HFS intake in the small smoker.	
2:01:31	2209	81	47.95030	-129.09704	Fluid sampling at a black smoker vent.	R1009-099
2:07:57	2209	83	47.95035	-129.09694	We have 300 degrees at this smoker!	

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
2:08:22	2209	83	47.95035	-129.09694	HFS unfiltered piston #1. Tmax=298.3 Tavg=295.8 T2=104.3 Vol=385mls Z=2209. Small smoker 2 meters east of RAS vent cover. SW Hulk. **R1009-HFS-0008 (Butterfield)**	
2:12:38	2209	83	47.95033	-129.09696	HFS filtered bag #9. Tmax=295.8 Tavg=290.6 T2=105.8 Vol=300mls Z=2209. Small smoker 2 meters east of RAS vent cover. SW Hulk. **R1009-HFS-0009 (Butterfield)**	
2:15:21	2209	83	47.95034	-129.09704	Gas tight bottle 5; hydraulic line #1. Tmax=295 Z=2209. Small smoker 2 meters east of RAS vent cover. SW Hulk. **R1009-gas-0010 (Evans)**	
2:17:09	2209	82	47.95037	-129.09703	Done fluid sampling. Going to get the RAS and put it in place now.	
2:17:09	2209	82	47.95037	-129.09703	We have just finished fluid sampling at this black smoker.	R1009-100
2:23:08	2207	296	47.95031	-129.09711	Picking up the RAS anchor to move it to the deployment site.	
2:25:42	2204	73	47.95030	-129.09713	Moving the RAS back to the T4 marker.	
2:27:17	2207	54	47.95036	-129.09708	Trying to decide exactly where to place the RAS itself.	
2:29:12	2206	78	47.95039	-129.09707	We are flying around to have a look at the area around the vent cover.	
2:30:32	2210	263	47.95041	-129.09695	Placed the anchor for the RAS.	
2:32:49	2207	323	47.95034	-129.09693	Going to remove the intake from the RAS.	
2:34:53	2208	336	47.95038	-129.09698	Going to need both arms to hold the frame and pull the intake loose.	
2:37:16	2206	296	47.95041	-129.09697	Grabbed the frame of the RAS. Going for the handle on the intake.	
2:38:22	2207	353	47.95038	-129.09700	RAS intake hose is loose on one side. Have to break free the other side.	
2:42:55	2206	309	47.95041	-129.09693	Still trying to pull loose the other side of the hose for the RAS intake.	
2:43:44	2206	307	47.95040	-129.09694	Hose is free. Taking the intake to vent cover to place it.	
2:44:22	2206	18	47.95038	-129.09703	The intake hose is about to be put into the vent cover.	R1009-101
2:47:46	2208	136	47.95043	-129.09706	Getting a better grip on the intake for placement in the vent.	
2:49:53	2208	135	47.95045	-129.09707	ROPOS inserted the intake hose into the vent cover.	R1009-102
2:49:59	2208	135	47.95045	-129.09707	RAS intake is in the hole of the vent cover. **RAS is deployed at SW Hulk.**	
2:57:06	2209	348	47.95034	-129.09698	Looking for sad looking tubeworms but are not going to bother as we have no biobox.	
2:59:12	2206	24	47.95036	-129.09703	Moving to Grotto to do some fluid sampling.	
3:01:53	2207	186	47.95029	-129.09702	ROPOS moving to Grotto.	R1009-103
3:02:35	2205	106	47.95022	-129.09703	Crypto's marker.	R1009-104
3:03:25	2209	227	47.95015	-129.09703	A crab is sitting on the seafloor.	R1009-105
3:04:33	2207	99	47.95004	-129.09708	DVD recorders have reached the 9-hour file limit and have been restarted.	
3:08:16	2219	205	47.94972	-129.09692	A crab sitting on the seafloor. We are getting closer to Grotto.	R1009-106
3:08:18	2218	205	47.94971	-129.09693	Continuing on the transit to Grotto.	
3:09:35	2213	213	47.94956	-129.09705	We need to move south to avoid some other large sulfides and chimneys.	
3:10:11	2205	236	47.94955	-129.09711	This is an old smoker.	R1009-107
3:14:46	2197	247	47.94943	-129.09753	Passing by Dudley.	
3:14:57	2198	235	47.94944	-129.09752	This is **Dudley**.	R1009-108
3:15:51	2205	240	47.94946	-129.09750	Here is a crab at Dudley.	R1009-109
3:16:41	2205	249	47.94943	-129.09752	Ridgeia worms on Dudley.	R1009-110
3:17:34	2205	241	47.94943	-129.09752	Positioning near Dudley.	
3:20:04	2204	259	47.94941	-129.09758	Moving around Dudley looking for a good spot to sample for fluids.	
3:20:13	2205	262	47.94942	-129.09757	Ridgeia worms at the bottom of Dudley vent.	R1009-111
3:23:36	2207	289	47.94941	-129.09750	Getting ready to sample the water from a lower area on Dudley vent.	
3:26:29	2207	289	47.94941	-129.09750	The temperature is going up - stopped at around 10-11C.	
3:26:40	2207	289	47.94941	-129.09750	Looking at the temperature.	R1009-112
3:31:57	2207	289	47.94944	-129.09752	Still probing for the highest temperature.	
3:35:28	2207	289	47.94946	-129.09753	Taking a sample here - t=13C.	
3:36:51	2207	289	47.94947	-129.09754	HFS Unfiltered Bag sample #10. Tmax=17.0 Tavg=15.6 Vol=589mls Z=2206. End time 03:41. Sampling a small diffuse flow on the SE side of Dudley. **R1009-HFS-0011 (Butterfield)**	
3:36:54	2207	289	47.94947	-129.09754	Unfiltered bag sample # 10; T= 15 C.	R1009-113
3:39:34	2207	289	47.94947	-129.09750	Ridgeia worms at Dudley sampling site.	R1009-114
3:41:36	2207	289	47.94946	-129.09750	Smaller Ridgeia worms at Dudley.	R1009-115

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
3:44:06	2207	289	47.94945	-129.09751	HFS Unfiltered Piston #4. Tmax=15.5 Tavg=14.3 Vol=740ml Z=2206. End time 03:48.50. Sampling a small diffuse flow on the SE side of Dudley. **R1009-HFS-0012 (Butterfield)**	
3:50:50	2207	289	47.94946	-129.09752	HFS Sterivex Filter #24. Tmax=16.7 Tavg=15.3 Vol=2028ml Z=2206 End time=04:70.00. Sampling a small diffuse flow on the SE side of Dudley. **R1009-HFS-0013 (Butterfield)**	
3:51:32	2207	289	47.94947	-129.09750	A vent fish in the Ridgeia worms at Dudley.	R1009-116
4:03:36	2207	289	47.94949	-129.09756	Continuing HFS Sterivex Filter #24.	R1009-117
4:07:42	2207	289	47.94954	-129.09759	Done sampling on Dudley vent and are heading to the top.	
4:10:11	2203	283	47.94951	-129.09756	Taking some digital stills on the way up to the top of Dudley.	
4:11:43	2198	276	47.94945	-129.09754	At the top of Dudley. A small black smoker was seen near the top.	
4:12:23	2197	286	47.94940	-129.09752	On top of Dudley.	R1009-118
4:13:04	2196	274	47.94936	-129.09755	Smoker on top of Dudley.	R1009-119
4:13:44	2195	269	47.94938	-129.09756	A nice big black smoker right on top of Dudley.	
4:15:26	2198	237	47.94939	-129.09760	Alvinellid worms at Dudley.	R1009-120
4:16:41	2198	235	47.94939	-129.09760	Top of Dudley - preparing to do a gas tight on the high temperature fluid.	
4:16:50	2198	235	47.94939	-129.09760	Smoker at Dudley.	R1009-121
4:18:13	2198	236	47.94939	-129.09760	HFS sampling at Dudley.	R1009-122
4:20:30	2198	232	47.94938	-129.09760	Sampling the black smoker.	R1009-123
4:20:55	2198	232	47.94938	-129.09760	The HFS sampling wand is in smoker. Initial temps are 110-140C.	
4:23:30	2198	230	47.94938	-129.09760	Temperature is around 270C - we are getting ready to sample.	
4:25:47	2198	223	47.94938	-129.09760	They broke the black smoker while sampling.	R1009-124
4:25:59	2198	224	47.94938	-129.09760	Pulling out the wand and are moving around a little to get in a better position.	
4:30:46	2198	232	47.94938	-129.09760	In a better position and have the wand back in the smoker. Temperature is 250 and climbing rapidly.	
4:31:41	2198	232	47.94939	-129.09759	The temperature probe is lost.	
4:31:59	2198	232	47.94938	-129.09760	HFS Unfiltered Bag #14. Tmax=? Tavg=?270? T2=140 Vol=511ml Z=2197. Sampling on a black smoker at the top of Dudley. **R1009-HFS-0014 (Butterfield)**	
4:32:03	2198	232	47.94938	-129.09760	Still sampling the black smoker at Dudley.	R1009-125
4:34:13	2198	232	47.94937	-129.09761	Taking gas tight bottle 15 - hydraulic line #3. Tavg=?270? T2=140 Z=2197. Black smoker on the top of Dudley. **R1009-gas-0015 (Evans)**	
4:37:25	2198	231	47.94937	-129.09760	The temperature probe on the end of the wand is acting funny. There could be a melted cable or something.	
4:38:55	2198	231	47.94936	-129.09759	HFS unfiltered piston #2. Tmax=? Tavg=? T2=147. Vol=300-350ml Z=2197m. Stopping at 04:42.50. Black smoker on the top of Dudley. **R1009-HFS-0016 (Butterfield)**	
4:43:53	2198	231	47.94936	-129.09758	We are done using the fluid sampler here and are stowing the wand.	
4:47:50	2198	230	47.94936	-129.09758	Taking a black smoker sample.	R1009-126
4:48:22	2198	230	47.94936	-129.09758	Grabbing some pieces of the sulfide chimney to put in purse. Most of the top portion has broken away.	
4:51:14	2198	335	47.94932	-129.09758	Piece of the broken chimney.	R1009-127
4:54:52	2198	334	47.94932	-129.09758	Small piece of black smoker.	R1009-128
4:55:40	2198	334	47.94932	-129.09758	A small piece of the sulfide chimney has been collected and placed into the purse. A second piece was added at 04:48. Black smoker on the top of Dudley. **R1009-RK-0017 (Labonte)**	
4:55:52	2198	334	47.94932	-129.09758	Taking a second piece of black smoker.	R1009-129
4:59:16	2198	333	47.94932	-129.09758	Closing purse and are getting ready to leave Dudley.	
5:01:40	2197	313	47.94933	-129.09757	Lifting off and heading to Grotto.	
5:05:33	2206	266	47.94926	-129.09743	Changing course to S&M instead of to Grotto.	
5:06:40	2209	203	47.94926	-129.09753	Going to S&M.	R1009-130
5:06:55	2211	200	47.94922	-129.09757	A crab sitting on the rocks.	R1009-131
5:08:43	2213	197	47.94896	-129.09769	On the right we can see a rift.	R1009-132
5:08:46	2213	194	47.94895	-129.09769	Traversing along the little rift.	
5:09:26	2217	192	47.94888	-129.09771	This is a closer look at the rift.	R1009-133
5:10:58	2218	198	47.94877	-129.09773	On the way to S&M.	R1009-134
5:21:39	2209	233	47.94807	-129.09850	On the way to S&M.	R1009-135

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
5:27:54	2209	170	47.94803	-129.09842	Still on the way to S&M.	R1009-136
5:28:11	2207	173	47.94800	-129.09839	Still looking around for S&M.	
5:29:23	2202	188	47.94796	-129.09838	Old chimneys on the S&M.	R1009-137
5:33:49	2198	8	47.94827	-129.09848	At S&M now. We are looking for some diffuse flow around the base.	
5:34:09	2198	346	47.94829	-129.09845	This is S&M vent.	R1009-138
5:34:54	2202	3	47.94830	-129.09848	A crab on the S&M vent.	R1009-139
5:35:28	2202	3	47.94830	-129.09849	There is a flange pool on this side. It looks great. Trying to get the DSC to get a picture.	
5:41:43	2201	180	47.94850	-129.09848	This is a marker from previous experiment.	R1009-140
5:42:47	2201	207	47.94851	-129.09844	This is an old marker at **S&M.**	R1009-141
5:43:01	2200	246	47.94851	-129.09842	Some old markers or experiments were spotted around here.	
5:44:11	2200	294	47.94851	-129.09835	Lots of instruments in this area.	
5:46:45	2201	165	47.94852	-129.09841	This one sampler is an abandoned Osmo-sampler.	
5:46:55	2201	165	47.94852	-129.09841	An old osmo-sampler.	R1009-142
5:48:59	2201	165	47.94852	-129.09841	Preparing to take a water sample here.	
5:50:58	2201	173	47.94850	-129.09839	HFS Sterivex filter #23. Tmax=30.4 Tavg=20.6 T2=15 Vol=1513ml Z=2201. Started at 05:54.45 and ends 06:06.57. Note: a short interruption in flow ~06:01. Sampling a diffuse vent. Base of S&M. **R1009-HFS-0018 (Butterfield)**	
5:51:42	2201	173	47.94851	-129.09839	HFS Sterivex filter #23 at S&M.	R1009-143
6:07:57	2201	174	47.94847	-129.09843	HFS Filtered bag #11. Tmax=27.7 Tavg=20.1 T2=10 Vol=591ml Z=2201m. Started 06:08.47 stopped at 06:13.30. A small diffuse vent. Base of S&M. **R1009-HFS-0019 (Butterfield/Opatkiewicz)**	
6:08:00	2201	174	47.94847	-129.09843	HFS filtered bag # 11.	R1009-144
6:21:01	2202	170	47.94848	-129.09839	Whelk at S&M.	R1009-145
6:21:20	2201	184	47.94848	-129.09838	Not taking the unfiltered fluid sample. Instead we looking for a high temperature vent to sample.	
6:22:53	2188	253	47.94839	-129.09832	A nice black smoker is spotted and ROPOS is moving in to sample it.	
6:23:39	2188	246	47.94840	-129.09834	The smoker is about 25m up the structure of S&M.	
6:23:59	2188	241	47.94841	-129.09837	Here are smokers on top of S&M.	R1009-146
6:25:33	2189	244	47.94841	-129.09837	Need to reposition - the bumper bar was brushing an overhead flange.	
6:26:56	2189	300	47.94838	-129.09841	This is a smoker on the side of S&M.	R1009-147
6:27:33	2188	299	47.94838	-129.09840	Maybe that was a little too close and are backing away to position again.	
6:31:14	2189	302	47.94839	-129.09841	HFS sampling in a black smoker at S&M.	R1009-148
6:31:20	2189	302	47.94838	-129.09841	We have the wand in the smoker about 25m up S&M. Temperatures around 150+ but then the probe starts giving inaccurate values.	
6:41:13	2189	302	47.94844	-129.09827	This is a close view of the HFS sampling at S&M.	R1009-149
6:42:37	2189	302	47.94844	-129.09832	HFS unfiltered piston #5. T1 is not functional Tmax=285.7 Tavg 280.7. T2=20-30 Vol=413ml Z=2188m. Actual start time ~06:46.00 end at 06:48.40. 25m up S&M. **R1009-HFS-0020 (Butterfield/Opatkiewicz)**	
6:49:38	2187	246	47.94840	-129.09832	Heading to Easter Island to recover the sediment trap and take some fluid samples.	
6:52:19	2201	28	47.94837	-129.09843	We're still at S&M and moving to Easter Island. Flange right in front of us.	
6:52:39	2202	39	47.94837	-129.09844	This is a view from underneath of S&M.	R1009-150
6:53:36	2202	30	47.94837	-129.09843	We're on the move now. Very beautiful flange fading from view.	
6:54:57	2199	249	47.94835	-129.09850	We are on the way to Easter Island vent.	R1009-151
7:01:39	2199	291	47.94825	-129.09936	We're back in the area of the chimneys. This is beautiful.	
7:01:56	2197	276	47.94826	-129.09938	Possibly Peanut; on the way to Jonathan's samples.	R1009-152
7:03:31	2200	258	47.94839	-129.09925	That's Jonathan's sediment trap. Looks like they caught some sediment.	
7:03:35	2201	262	47.94839	-129.09925	Sediment trap belonging to Jonathan.	R1009-153
7:06:45	2201	22	47.94838	-129.09947	Marker E	R1009-154
7:07:36	2203	78	47.94844	-129.09943	Weird structures close to the marker E; Main Endeavour field.	R1009-155
7:07:37	2203	83	47.94844	-129.09943	Looking around this complex in the main Endeavour field. Setting up and looking around.	
7:10:39	2203	187	47.94849	-129.09935	Beehives again...	R1009-156
7:10:44	2203	180	47.94849	-129.09936	Discussing what to do here...	
7:11:46	2204	165	47.94845	-129.09938	Tubeworms and shimmering water.	R1009-157

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
7:14:17	2204	167	47.94844	-129.09940	We're at **Easter Island** and will be taking a fluid sample here.	
7:14:21	2204	167	47.94844	-129.09940	Preparing to take fluid sample on Easter Island.	R1009-158
7:14:51	2204	167	47.94845	-129.09940	HFS piston #3. T1 was unusable. T2=14-17 Vol=553ml Start time at 07:29.40 ended at 07:33.30. Z=2204. Tubeworm Vent at Easter Island. **R1009-HFS-0021 (Butterfield)**	
7:16:00	2204	167	47.94844	-129.09938	While taking fluid samples on Easter Island.	R1009-159
7:21:20	2204	169	47.94844	-129.09938	Fluid Sample on tubeworms; Easter Island.	R1009-160
7:35:29	2204	170	47.94842	-129.09938	HFS Sterivex filter #22. T1 was non-functional. T2=13.3-15 Vol=2003ml Z=2204. Sampling a diffuse vent. Started at 07:36.26 and ends 07:51. Tubeworm Vent at Easter Island. **R1009-HFS-0022 (Butterfield)**	
7:39:09	2204	169	47.94842	-129.09937	Red creatures observed during fluid sampling.	R1009-161
7:41:23	2204	169	47.94841	-129.09936	Crab observed during fluid sampling.	R1009-162
7:52:50	2204	169	47.94844	-129.09940	Sampling gastight bottle 11 - hydraulic line #2. 30 second sample. T2=13.3-15 Z=2204. Tubeworm Vent at Easter Island. **R1009-gas-0023 (Evans)**	
7:57:05	2204	169	47.94843	-129.09941	Gastight sample at Easter Island.	R1009-163
7:58:23	2204	169	47.94843	-129.09941	Stowing the HFS wand and will now continue with Jonathan's samples.	
7:59:56	2204	169	47.94843	-129.09940	Moving to a position to get some suction samples.	
8:06:33	2205	273	47.94839	-129.09934	Alvin drop weight?	R1009-164
8:06:35	2205	273	47.94839	-129.09934	We're looking around here at an Alvin weight.	
8:06:55	2205	273	47.94839	-129.09934	Alvin drop weight? Close-up.	R1009-165
8:08:14	2205	273	47.94840	-129.09935	Flushing jar 8 getting ready to suction for Jonathan. He will suction up rocks and sed in the area before recovering the sed trap.	
8:09:44	2205	273	47.94841	-129.09935	Jar #2 180 micro mesh. Will sample the rocks around the trap.	
8:11:34	2205	273	47.94841	-129.09935	Suction sample rocks near the sediment trap into Jar 2. 180 micro mesh. Start 0812 Stop 0817. Z=2205. Easter Island. **R1009-SS-0024 (Rose)**	
8:13:12	2205	273	47.94841	-129.09935	Suction sampling of the rocks surrounding the sediment trap.	R1009-166
8:18:00	2205	272	47.94841	-129.09936	We will switch to jar 1 next - to see what larvae etc. are in the seds.	
8:20:43	2205	272	47.94839	-129.09936	Suction sample into jar 1 (180 micron mesh). Suctioning the surface of the sediment trap (which has been out here 3 years). Having a hard time..... Not much in the jar. Z=2205. Easter Island. **R1009-SS-0025 (Rose)**	
8:21:40	2205	272	47.94839	-129.09936	Suctioning off of sediment trap.	R1009-167
8:29:38	2205	238	47.94841	-129.09931	There is not much in that jar.	R1009-168
8:31:55	2205	238	47.94841	-129.09930	Francoise wants a piece of a little sulfide chimney. Will have to be near here.	
8:35:52	2202	153	47.94850	-129.09937	Looking at a possible sample here. Francoise wants one of the little gray mounds that hot water is flowing out of.	
8:35:59	2202	141	47.94850	-129.09937	We are preparing to take a sulfide sample.	R1009-169
8:38:05	2205	234	47.94847	-129.09931	We're looking at this structure at Easter Island.	
8:38:45	2205	235	47.94848	-129.09931	We are preparing to sample this sulfide.	R1009-170
8:39:00	2205	235	47.94847	-129.09931	DVCam tape ended. Not going to put in another because we're almost finished with this dive.	
8:40:18	2205	238	47.94847	-129.09930	Sampling the sulfide.	R1009-171
8:40:45	2205	232	47.94847	-129.09930	Trying to get a bit of this structure. Looks like it's breaking apart. Not sure if we will get any of it.	
8:41:02	2205	232	47.94847	-129.09930	Sampling the sulfide.	R1009-172
8:41:47	2205	232	47.94847	-129.09930	The top has broken off and they are trying to grab a piece.	
8:42:15	2205	232	47.94847	-129.09931	ROPOS has recovered a small piece of the sulfide.	R1009-173
8:42:15	2205	232	47.94847	-129.09931	Piece of the top of this small squat chimney. Lots of flow coming out. Quite crumbly. Placed the piece in the sediment trap. Hopefully it will be there at the surface. Z=2205. **Lost it** with the sediment trap at surface! Easter Island. **R1009-RK-0026 (Labonte)**	
8:44:49	2205	229	47.94839	-129.09932	ROPOS is placing the sulfide in the sediment sampler.	R1009-174
8:45:55	2205	229	47.94840	-129.09932	Next will grab the sediment trap by the hockey puck and carry it to the surface.	
8:47:38	2205	186	47.94840	-129.09935	Sediment trap (settling array) recovered after 3 years on the bottom. Purpose was to look for larval settlement. Has a rosette of 24 bottles that would move every 2 weeks (for a temporal study). Z=2205. Fell out of the arm at surface. **Lost it!** Easter Island. **R1009-sedtrap-0027 (Rose)**	
8:47:41	2205	186	47.94840	-129.09935	ROPOS picking up the sediment trap.	R1009-175
8:48:30	2205	189	47.94839	-129.09934	Sediment trap is secure. ROPOS preparing to leave the bottom.	R1009-176

Time	Z	Hdg	raw lat	raw long	R1009 Comments: Main Endeavour Field	FrGrab
8:48:39	2205	189	47.94839	-129.09934	We're will be heading to the surface.	
8:49:11	2205	189	47.94839	-129.09935	Transferring digital images.	
8:49:54	2205	189	47.94839	-129.09935	Checking gauges. Still on the bottom.	
8:52:22	2205	189	47.94838	-129.09935	Leaving the bottom. End of dive R1009.	
10:11:50	76	191	47.94804	-129.09938	Floats are clearing the surface now.	
10:22:05	28	243	47.94793	-129.09944	The settling tray just fell to the bottom. We're going to mark the spot.	
10:23:48	27	250	47.94790	-129.09912	The position here is: 47°56.8786' 129°5.9458'. In case they return and try to recover the sediment trap in the future.	
10:26:44	5	246	47.94787	-129.09893	ROPOS is at the surface.	
10:29:19	3	254	47.94798	-129.09879	ROPOS on deck. End of dive R1009.	

5.6.3 R1010 - Pressure Dive (Axial)

R1010 Axial caldera, '98 lava flow, S. Pillow Mound - Pressure dive. [R1010 Bottom time: 8/29 1637 - 8/31 1918 minus 28 hours transit above the bottom (25 hrs 19 min)] Started the dive looking at the NeMO Net anchor at the caldera center, hoping to get a clue about the disappearance of the NeMO Net buoy. Cut the line from the release up to the buoy so it would be free to recover on the next visit during this cruise. The line from the anchor toward the top end was stretched out about 50 meters to the NW. It looks like the buoy broke loose under relatively moderate conditions. It was not dragged, and the winds were likely from the SE. 3 pressure transects (at benchmarks at the caldera center; Magnesia; Mkr-33; Bag City; and South Pillow Mound). Deployed and recovered temperature probes (hobos and MTRs) on the 98 lava flow. *On this dive verified the navigation problem by doing some tests spinning the ship etc.* 9 samples total. Caldera center: 1SS of sed for glass. S of Magnesia: 1 SS of sed. for glass. Mkr-33: 2 SS sed for biota. Castle: 1 anhydrite piece, 1 SS blue mat, 1 grab of tubeworms and blue mat. Village: 1 SS of blue mat. Bag City: 1 SS sed for glass. Other vents visited include Cloud and Vixen. Discovered new diffuse venting near Magnesia and named the site Forum. Record breaking dive: > 53 hours long.

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
15:15:14	1	54	47.94789	-129.09897	ROPOS is in the water. Dive was delayed a day due to the AUV search.	
15:21:48	46	265	45.94415	-130.00824	All the floats have been added - ROPOS is heading down.	
15:29:13	96	220	45.94406	-130.00821	There are some problems with the DSC at the moment. Problems resolved now.	
15:55:04	619	233	45.94382	-130.00850	Descent continues - on our way to check the site of the NemoNet buoy.	
16:36:45	1465	215	45.94442	-130.00793	Getting close to the bottom.	
16:41:14	1542	224	45.94444	-130.00794	DVCAM and DVD are recording.	
16:42:24	1545	220	45.94432	-130.00806	Bottom is pretty rugged here.	R1010-001
16:42:47	1545	218	45.94428	-130.00813	Heading to the **NemoNet buoy location**. Lots of jumbled flows here. Sponges and a starfish have been seen.	
16:43:27	1546	219	45.94423	-130.00820	Anchor location is in front of us.	
16:45:44	1544	279	45.94415	-130.00840	Setting up a search pattern to find the anchor point.	
16:47:35	1544	167	45.94401	-130.00847	Close to the **anchor location**. Starting a radial line search pattern.	
16:48:33	1544	162	45.94403	-130.00847	Not much sediment on the bottom.	R1010-002
16:49:32	1544	164	45.94385	-130.00837	Anchor is 6850 lbs so should show up on SONAR.	
16:52:11	1545	183	45.94343	-130.00837	At the southern end of the south radial line. Heading back north.	
16:53:29	1545	90	45.94347	-130.00815	Lots of starfish.	R1010-003
16:54:02	1544	358	45.94353	-130.00800	We are offset 20m to the east and are heading north now.	
16:57:37	1546	155	45.94423	-130.00828	Getting ready to do the south east radial line.	
16:59:07	1546	147	45.94399	-130.00804	A target seen to the starboard a bit.	
17:00:17	1546	150	45.94391	-130.00797	A little more sedimented here.	R1010-004
17:00:59	1544	127	45.94382	-130.00787	Continuing along transect.	
17:02:58	1544	141	45.94362	-130.00758	Nice pillow basalt flow.	R1010-005
17:03:05	1544	200	45.94361	-130.00755	No in an area of some nice pillow flows.	
17:10:16	1544	86	45.94418	-130.00769	Heading off on the east radial.	
17:13:49	1538	177	45.94401	-130.00686	Still no sight of the anchor.	
17:16:00	1539	185	45.94350	-130.00691	Doing a large circle around the anchor position to **look for the cable**.	
17:19:56	1545	275	45.94300	-130.00801	Some work on the surface is being done to see if we can triangulate where the acoustic release is located.	
17:20:59	1545	347	45.94318	-130.00813	Back in the rough flows.	R1010-006
17:22:01	1545	266	45.94337	-130.00828	Due south of the anchor point and are proceeding clockwise around the point.	
17:24:03	1545	322	45.94349	-130.00879	A fish.	R1010-007
17:26:18	1545	322	45.94369	-130.00957	In a closer circle transect about the anchor point now. Still no sight of the cable.	
17:32:06	1546	23	45.94514	-130.01023	Flat sheet flow with good sediment cover.	R1010-008
17:32:59	1545	65	45.94533	-130.00990	Line spotted.	
17:33:44	1544	69	45.94530	-130.00980	**A lot of line tangled up here.**	R1010-009
17:34:28	1543	83	45.94541	-130.00980	The line has formed a pretty regular pattern.	R1010-010
17:35:59	1544	100	45.94513	-130.00973	Big mess in line here.	R1010-011
17:36:18	1541	99	45.94506	-130.00971	A single strand here.	R1010-012
17:37:03	1543	88	45.94492	-130.00968	Bigger coils again.	R1010-013
17:38:18	1543	67	45.94472	-130.00951	Release spotted here.	R1010-014
17:38:34	1544	14	45.94470	-130.00945	Another shot of the release.	R1010-015
17:39:06	1546	14	45.94471	-130.00944	The release and chains.	R1010-016
17:39:35	1546	20	45.94471	-130.00946	Picking up the **acoustic release** to see how it looks.	
17:41:15	1546	21	45.94472	-130.00945	Having trouble picking up the acoustic release to see if the end has been triggered.	
17:44:12	1543	24	45.94470	-130.00944	Pulling the release away from the tangled line.	
17:44:59	1546	36	45.94468	-130.00946	The acoustic release has been successfully pulled off the bottom anchor. Now to cut the line.	
17:48:17	1546	41	45.94472	-130.00945	Rope is cut. The acoustic release will be left here and picked up on another dive.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
17:49:23	1545	40	45.94466	-130.00941	Heading to the anchor to see if they are upright.	
17:50:02	1544	6	45.94471	-130.00929	Anchors look good.	R1010-017
17:51:04	1542	330	45.94470	-130.00930	Going to the upper end of the mooring to see what the line looks like.	
17:55:39	1544	337	45.94603	-130.00968	Still looking for the end of the cable.	
17:56:12	1546	320	45.94620	-130.00969	There are some barnacles here. They are from the top of the line.	
17:56:47	1547	319	45.94620	-130.00969	Crabs are feasting on barnacles from the line.	R1010-018
17:57:33	1548	307	45.94623	-130.00970	Close up of feasting crabs.	R1010-019
17:58:23	1548	307	45.94623	-130.00971	Maybe some different types of crabs here.	
18:00:00	1545	241	45.94634	-130.00970	Having difficulty spotting the top of the line.	
18:01:03	1543	120	45.94631	-130.00985	The end of the line is to the NW of the anchor.	
18:01:36	1545	131	45.94629	-130.00980	The chain must be in this area.	
18:04:26	1547	172	45.94628	-130.00978	Going to pick up the line to see if it is chain or rope.	
18:04:54	1547	172	45.94628	-130.00978	We're trying to find the end of the chain.	R1010-020
18:05:16	1547	172	45.94629	-130.00976	Appears to be rope.	
18:07:10	1545	284	45.94626	-130.00966	Heading to the centre site for the start of the pressure survey. DVCAM and DVD have stopped recording.	
18:15:59	1442	0	45.94472	-130.00873	Transect will take some time.	
19:05:46	1531	359	45.95497	-130.01003	We're on the bottom heading to the benchmark in the middle of the caldera. Started recording video again at 1907.	
19:11:44	1531	65	45.95495	-130.01011	Whirly sheet flows here. Lots of sediment.	
19:12:18	1530	23	45.95497	-130.01010	Nice ropey sheet lava flows here.	R1010-021
19:13:57	1530	4	45.95520	-130.01001	It is pretty jumbled here.	R1010-022
19:14:41	1530	323	45.95529	-130.01000	We found the benchmark (63) at the caldera center.	
19:14:43	1531	322	45.95529	-130.01000	**Marker 63 is spotted - this is the caldera centre.**	R1010-023
19:15:41	1532	258	45.95543	-130.01002	We need to sit down first and have a specific heading. It's important not to move the benchmark (table).	
19:18:22	1533	11	45.95541	-130.01009	An anchor to the BPR.	R1010-024
19:18:35	1535	9	45.95542	-130.01012	We're close to setting down here. Rueben (the pilot) is lining up the vehicle. The benchmark platform is in front of us. Want to use the same heading each time we come here.	
19:18:59	1536	6	45.95542	-130.01011	Pressure sensor platform (#63) here.	R1010-025
19:25:48	1536	8	45.95541	-130.01011	Quite devoid of fauna here. An occasional starfish and sponge. We're preparing to grab the sensor.	
19:28:01	1536	8	45.95542	-130.01010	Placing the **pressure sensor** on the benchmark. Closer to the edge and parallel is the key.	
19:28:04	1536	8	45.95542	-130.01010	Placing the pressure sensor.	R1010-026
19:29:32	1536	8	45.95542	-130.01011	Rearranging it so that it's parallel to the edge.	
19:29:46	1536	8	45.95542	-130.01011	Doing some adjustments.	R1010-027
19:30:02	1536	8	45.95542	-130.01011	The sensor is in place and is now starting the 20 minute measurement.	
19:30:14	1536	8	45.95542	-130.01011	Starting the pressure sensor test.	R1010-028
19:33:53	1536	8	45.95542	-130.01011	Another snap of the pressure measurement here at Benchmark 63 - caldera center.	R1010-029
19:34:26	1536	8	45.95542	-130.01011	Took a couple DSCs here too.	
19:48:11	1536	8	45.95540	-130.01019	Turned the video back on at 1947:23.	
19:50:06	1536	8	45.95540	-130.01020	Right before ending the measurement.	R1010-030
19:50:42	1536	8	45.95540	-130.01020	We're preparing to retrieve the pressure sensor.	
19:52:57	1536	8	45.95539	-130.01020	Grabbing the hockey pucks on the top of the sensor and lifting it off the benchmark now.	
19:55:44	1536	8	45.95539	-130.01021	The pressure sensor is stored. We will be heading to Magnesia next.	
20:00:52	1536	8	45.95539	-130.01023	The pressure sensor is stowed.	
20:02:01	1536	8	45.95539	-130.01022	We are departing the site.	
20:02:30	1532	18	45.95537	-130.01024	2003 - Video off for 1 hour transit to Magnesia.	
21:54:08	1518	133	45.94664	-129.98576	We're approaching Magnesia and Benchmark 1. Still off the bottom.	
21:56:21	1526	132	45.94649	-129.98517	We're on the bottom here at Magnesia. Started the video. Lots of pillars in the area.	
21:56:54	1527	150	45.94638	-129.98502	Lava pillars here at Magnesia.	R1010-031
21:57:00	1528	150	45.94635	-129.98499	The top of a lava pillar.	R1010-032
21:58:11	1526	118	45.94619	-129.98465	Ctenophore here swimming above the pillars.	R1010-033
21:58:45	1527	137	45.94618	-129.98462	This animal was observed while searching for the Magnesia benchmark.	R1010-034
21:58:56	1526	128	45.94617	-129.98463		R1010-035
22:00:18	1525	149	45.94618	-129.98457	Ctenophore here at Magnesia.	
22:01:23	1526	140	45.94623	-129.98441	Three lava pillars freestanding	R1010-036
22:01:45	1525	136	45.94620	-129.98433	Pillars and roof here at this collapse area.	R1010-037
22:01:46	1525	136	45.94619	-129.98433	We're snapping lots of images of this collapse area. A ctenophore and fish in the area.	
22:03:35	1527	268	45.94620	-129.98475	We're looking at pillars and the collapse here.	R1010-038

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
22:03:41	1527	267	45.94620	-129.98479	The roof of a pillar area.	R1010-039
22:04:04	1527	324	45.94621	-129.98495	A large lonely lava pillar.	R1010-040
22:04:21	1529	360	45.94627	-129.98497	Beautiful lava pillars.	R1010-041
22:04:25	1529	360	45.94630	-129.98497	Lots of pillars and roofs.	R1010-042
22:07:17	1527	63	45.94683	-129.98504	A lava arch.	R1010-043
22:08:10	1525	90	45.94685	-129.98482	Lava pillars and roofs.	R1010-044
22:08:46	1526	91	45.94684	-129.98462	We're looking around here at Magnesia.	
22:09:35	1524	182	45.94684	-129.98451	Up here it's 50 percent collapsed everywhere.	
22:09:51	1524	161	45.94676	-129.98451	We're heading back south looking for the benchmark.	
22:13:20	1527	176	45.94650	-129.98480	Free standing lava pillars located near Magnesia.	R1010-045
22:17:50	1527	13	45.94642	-129.98450	We see iron oxide staining between these ropey flows.	
22:18:26	1527	85	45.94651	-129.98452	We're looking for the benchmark here.	
22:18:59	1527	76	45.94652	-129.98439	We're seeing shimmer here and bacterial mat plus tubeworms.	
22:19:05	1527	81	45.94653	-129.98437	Tubeworms on lobate lava crust.	R1010-046
22:19:22	1526	78	45.94654	-129.98434	White bacterial mats growing on and near lava pillars	R1010-047
22:20:04	1526	281	45.94658	-129.98435	We are dubbing this place **"The Forum"** - because the pillars look like Roman columns. We're **47 meter N/NE of the benchmark**. There is lots of shimmering water here and tubeworms.	
22:28:03	1528	177	45.94657	-129.98505	Bathtub rings on the edge of a collapse pit. A lava pillar is located in the foreground.	R1010-048
22:31:03	1526	129	45.94591	-129.98495	We're moving the DSC files.	
22:33:03	1528	359	45.94611	-129.98485	We're looking around still searching for the benchmark.	
22:36:53	1529	262	45.94591	-129.98446	Lava pillar attached to the collapse wall at the top. There are well defined bathtub rings in the collapse wall.	R1010-049
22:38:27	1528	18	45.94606	-129.98462	Still searching.	
22:49:23	1526	11	45.94620	-129.98537	***We found the benchmark after much searching. We're due west of the former target by 30 meters. Benchmark 1 is right ahead of us.***	
22:49:42	1527	6	45.94625	-129.98535	We located Marker 67.	R1010-050
22:50:55	1529	57	45.94632	-129.98534	**We're at Mkr-67 - here at Bmrk-1 (Magnesia Vent site).**	
22:55:27	1529	46	45.94634	-129.98531	Retrieved the pressure sensor and are placing it on the benchmark.	
22:58:29	1529	46	45.94634	-129.98531	**We are starting the measurement now.**	
22:58:31	1529	46	45.94634	-129.98531	Starting pressure measurement at benchmark 67.	R1010-051
22:58:46	1528	46	45.94634	-129.98531	Stopping the video now.	
23:19:07	1529	45	45.94633	-129.98531	Stopped pressure measurement.	
23:23:15	1529	45	45.94634	-129.98532	Picking up the sensor again.	
23:27:01	1529	46	45.94633	-129.98539	Leaving the benchmark. We will stop in the collapse to pick up a rock for ballast.	
23:29:45	1529	222	45.94599	-129.98541	Lava pillar with yellow staining at the base.	R1010-052
23:29:59	1531	231	45.94597	-129.98543	A close up of staining in the cracks at the base of this lava pillar.	R1010-053
23:30:44	1533	223	45.94597	-129.98544	Picking up a rock for ballast.	
23:39:18	1533	222	45.94591	-129.98548	We are collecting rocks for ballast.	R1010-054
23:40:46	1533	221	45.94590	-129.98549	Rock broke so we are trying for another one.	
23:42:56	1517	117	45.94599	-129.98534	Ballast is still off. Going back for another rock.	
23:50:26	1525	236	45.94575	-129.98502	Lifting off and heading to Marker 33.	
23:51:46	1508	143	45.94538	-129.98456	Stopped recording video.	
1:04:11	1518	178	45.93358	-129.98242	Back on the bottom. Heading to Marker 33.	
1:04:40	1520	178	45.93350	-129.98240	We've sighted the bottom and are searching for Marker 33.	R1010-055
1:05:49	1523	185	45.93334	-129.98246	Started recording video.	
1:06:26	1524	219	45.93333	-129.98251	Found an old ROPOS elevator anchor.	
1:07:52	1523	270	45.93333	-129.98262	Looks like there is still good venting here.	
1:08:47	1523	270	45.93341	-129.98274	**We are at the benchmark at Marker 33.**	
1:10:34	1524	119	45.93344	-129.98284	A tubeworm colony located near Marker 33 - this is near the benchmark.	R1010-056
1:12:06	1524	116	45.93346	-129.98285	Picking up the pressure sensor.	
1:17:39	1524	115	45.93340	-129.98282	Trying to get the pressure sensor in the correct orientation.	
1:21:41	1524	115	45.93346	-129.98278	Discussing whether this is the right orientation or not.	
1:22:33	1524	115	45.93348	-129.98275	We are now taking a **pressure measurement at the Marker 33 benchmark 5.**	R1010-057
1:24:00	1524	115	45.93347	-129.98274	Another shot of the tubeworm colony.	R1010-058
1:24:13	1524	115	45.93347	-129.98274	Started measurement at 01:22.	
1:24:32	1524	115	45.93346	-129.98274	We've zoomed in to get a close-up of the colony of tubeworms.	R1010-059
1:27:28	1524	115	45.93348	-129.98274	More tubeworms are in the area of the benchmark.	R1010-060
1:42:31	1524	115	45.93349	-129.98264	Stopped pressure measurement. Picking up the sensor.	
1:43:43	1524	115	45.93350	-129.98261	The first pressure measurement at Marker 33 is over (Benchmark 5). We are collecting the equipment.	R1010-061
1:44:55	1524	115	45.93350	-129.98261	Restarted video.	
1:46:55	1519	79	45.93346	-129.98276	Leaving Marker 33 and heading to Bag City.	
3:13:41	1536	206	45.91683	-129.98222	The seafloor is in sight. We have started recording onto DVD and DVCAM.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
3:16:17	1536	249	45.91641	-129.98259	We are moving along the basalt and looking for Bag City.	
3:16:57	1536	222	45.91631	-129.98275	Jumbled lava here - a collapsed area.	R1010-062
3:17:19	1535	228	45.91628	-129.98282	We are in a collapsed area. The basalt is jumbled.	
3:20:13	1537	78	45.91632	-129.98238	We've spotted a couple of fish sitting motionless on the seafloor.	
3:20:13	1537	78	45.91632	-129.98238	Rattail sitting on the seafloor.	R1010-063
3:25:16	1535	279	45.91614	-129.98278	We have started to make a search pattern in order to find Bag City.	
3:27:12	1533	31	45.91625	-129.98312	We are looking for part of the flow that has not collapsed (so far all we are seeing is jumbled basalt). We have not seen this yet indicating that we are in the wrong area. The search pattern continues.	
3:30:11	1535	139	45.91646	-129.98280	The target that we were looking for was input incorrectly. We are therefore in the wrong place; i.e. 500 meters east of the target.	
3:36:01	1535	274	45.91617	-129.98344	Heading east along the seafloor.	
3:37:11	1534	276	45.91616	-129.98354	Bag City is in pre-1998 Lava Flow.	
3:49:41	1529	278	45.91618	-129.98698	We are 180 meters east of the target and moving out of the jumbled basalt.	
3:56:22	1534	275	45.91619	-129.98879	We are now reaching the end of a collapse. The Bag City benchmark is near an edge like this but there may be other ones. We are going to continue towards the target.	
4:01:20	1533	201	45.91616	-129.98936	We are beginning a search pattern from where we are now.	
4:08:22	1533	90	45.91638	-129.98978	We have **found the benchmark at Bag City**.	
4:14:51	1534	16	45.91640	-129.98970	Picking up the pressure sensor.	
4:17:40	1534	7	45.91640	-129.98969	Placing the pressure sensor on the benchmark and simultaneously adjusting its position.	
4:18:43	1534	7	45.91640	-129.98969	Pressure sensor in place. Pressure measure start time: 04:18. DVD and DVCAM stopped.	
4:18:52	1534	7	45.91640	-129.98969	We put the pressure monitor into place and began measurement at Bag City.	R1010-064
4:40:38	1534	5	45.91642	-129.98966	Unidentified floating object.	R1010-065
4:40:50	1534	5	45.91642	-129.98966	End of the pressure measurement at 04:40.	
4:41:39	1534	5	45.91641	-129.98970	DVD and DVCAM recording start.	
4:42:46	1534	5	45.91641	-129.98970	Pressure sensor has been lifted off of the benchmark.	
4:43:03	1534	5	45.91641	-129.98970	Returning the pressure sensor to ROPOS.	R1010-066
4:45:31	1534	5	45.91642	-129.98966	The pressure sensor is being secured to ROPOS.	
4:48:08	1534	5	45.91640	-129.98967	Pressure sensor secured. We are now moving on to the next target (Pillow Mound).	
9:51:21	1722	238	45.86314	-130.00358	Back on the bottom after a **5 hour transit**!	
9:51:41	1723	191	45.86315	-130.00368	We are at the bottom searching for Axial benchmark 66 at the South Pillow Mound.	R1010-067
9:52:18	1723	283	45.86321	-130.00382	We're here looking around for **Axial benchmark 66 - at the South Pillow Mound.**	
9:52:56	1723	301	45.86330	-130.00402	Marker found in one minute!	R1010-068
9:52:59	1723	310	45.86330	-130.00403	We found the benchmark and the fissure.	
9:53:14	1721	1	45.86331	-130.00409	The 1998 lava flow fissure here at South Pillow Mound.	R1010-069
9:53:35	1723	353	45.86334	-130.00410	The 1998 lava flow fissure here at South Pillow Mound.	R1010-070
9:54:17	1722	345	45.86338	-130.00407	Rat tail fish.	R1010-071
9:54:57	1719	337	45.86333	-130.00409	Took some digitals and frame grabs of the fissure and benchmark here.	
9:55:17	1722	12	45.86335	-130.00416	The marker and benchmark.	R1010-072
9:56:01	1723	9	45.86336	-130.00416		R1010-073
9:56:02	1723	9	45.86336	-130.00416	Keith is preparing to pick up the sensor.	
9:58:41	1723	9	45.86338	-130.00409	The sensor is out of the holster and being placed on the benchmark.	
9:59:21	1723	8	45.86337	-130.00409	Installing the pressure sensor on its support.	R1010-074
10:00:44	1723	8	45.86333	-130.00410	We're starting the pressure measurement now at 0300 PST 1000 UTC.	
10:00:49	1723	8	45.86333	-130.00410	We are starting the pressure measurement.	R1010-075
10:01:18	1723	8	45.86333	-130.00411	Turning the video off now.	
10:03:44	1723	8	45.86336	-130.00405	***This position is 40 meters NW of the 2004 position.***	
10:20:01	1724	8	45.86342	-130.00396	We're done. Let's go.	
10:20:16	1724	8	45.86342	-130.00396	Finished with pressure reading.	R1010-076
10:21:34	1724	8	45.86341	-130.00395	Started the video. Just after that the pressure sensor fell off the benchmark.	
10:21:44	1723	8	45.86341	-130.00395	The pressure sensor has fallen...	R1010-077
10:23:43	1723	10	45.86341	-130.00398	We're going to put the sensor back on the benchmark and make sure there is no "tear" in the data.	
10:23:55	1723	10	45.86341	-130.00398	We will verify if the data of the sensor before moving to another site.	R1010-078
10:28:35	1724	353	45.86342	-130.00395	Big Keith is picking up the pressure sensor and will place it on the benchmark again.	
10:31:43	1724	0	45.86341	-130.00395	Keith is setting the sensor on the benchmark now.	
10:34:43	1724	0	45.86341	-130.00397	Checking to see if this reading is consistent with the measurement earlier (before the tumble).	
10:35:36	1724	0	45.86342	-130.00397	The data look fine. We're going to pick it up and put it in the cradle.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
10:35:52	1724	0	45.86342	-130.00397	Everything looks ok. We will continue the dive.	R1010-079
10:38:41	1724	0	45.86343	-130.00401	The sensor is in the holster.	
10:38:54	1724	0	45.86343	-130.00401	It's about 6 km to Bag City.	
10:39:47	1724	0	45.86343	-130.00402	We still have 6 km until the next point (all the way back on the line).	R1010-080
10:40:03	1724	0	45.86344	-130.00403	We're finished down here. 6 km at 010 to Bag City.	
10:41:38	1721	63	45.86352	-130.00348	We're turning the video off now.	
14:50:36	1654	8	45.87019	-130.00183	On the bottom on the way Bag City.	
14:51:46	1654	8	45.87019	-130.00183	Video records started at 10:51.	
15:01:47	1534	49	45.91642	-129.98955	**Spotted the Bag City benchmark (benchmark 4).**	
15:02:33	1533	34	45.91647	-129.98950	The Bag City marker.	R1010-081
15:03:14	1534	41	45.91647	-129.98950	The Bag City bench.	R1010-082
15:06:50	1534	41	45.91647	-129.98949	The pressure transducer almost in place.	R1010-083
15:07:53	1534	41	45.91648	-129.98949	The pressure sensor has been placed - but it needs to be straightened out.	
15:08:38	1534	41	45.91647	-129.98949	The pressure transducer in place.	R1010-084
15:09:37	1534	41	45.91647	-129.98949	**Starting the measurement.**	
15:29:27	1534	40	45.91645	-129.98950	Done with the pressure test here. Starting to record video again.	
15:33:50	1534	40	45.91646	-129.98951	The table after removal of pressure sensor.	R1010-085
15:34:07	1534	40	45.91646	-129.98950	Heading over to waypoint 80. Video is still recording.	
15:34:37	1534	43	45.91646	-129.98950	Post measurement table position on the fly.	R1010-086
15:36:17	1531	58	45.91646	-129.98945	Tube worms NE of table.	R1010-087
15:36:40	1534	51	45.91649	-129.98941	Lots of healthy tubeworms in this area. It is a pretty extensive set of bushes.	
15:37:16	1533	25	45.91653	-129.98934	**Marker 36 is in sight. This is the Bag City vent.**	
15:37:18	1533	29	45.91653	-129.98933	Mkr 36 Bag City Vent.	R1010-088
15:38:00	1534	69	45.91658	-129.98932	An area of diffuse flow is spotted.	
15:39:34	1535	105	45.91661	-129.98931	The heart of Bag City vent.	R1010-089
15:40:42	1535	105	45.91662	-129.98931	Looking for other areas of venting.	
15:41:19	1535	105	45.91662	-129.98931	The carcass of the old NeMO Net camera: top left.	R1010-090
15:42:27	1533	86	45.91660	-129.98933	The carcass of the old NeMO Net camera in the background.	R1010-091
15:44:12	1535	84	45.91656	-129.98924	Spotted a second area of diffuse venting. It is smaller than the first.	
15:47:05	1534	28	45.91668	-129.98924	Heading to Marker 33. Stopping video.	
17:06:28	1518	26	45.93225	-129.98322	Back on the bottom heading to the site. Video has been started.	
17:10:58	1519	26	45.93299	-129.98287	About 100m south of the Marker 33 benchmark.	
17:24:25	1523	50	45.93338	-129.98283	Still searching for the benchmark.	
17:30:56	1523	25	45.93342	-129.98238	**Spotted the marker for the benchmark north of Mkr-33.**	
17:30:56	1523	25	45.93342	-129.98238	Mkr 33's benchmark table has been found.	R1010-092
17:31:27	1522	46	45.93349	-129.98241	A shot of the benchmark as we approach.	R1010-093
17:34:28	1523	105	45.93355	-129.98240	A shot of the table.	R1010-094
17:34:40	1523	105	45.93355	-129.98240	Getting prepared to place the pressure sensor.	
17:35:46	1523	105	45.93356	-129.98240	Placing the pressure sensor on the benchmark.	R1010-095
17:38:45	1523	104	45.93355	-129.98242	**The pressure sensor is in place.**	R1010-096
17:38:49	1523	104	45.93355	-129.98242	The pressure sensor has been placed and the video has been turned off.	
17:45:16	1523	104	45.93352	-129.98249	A large tubeworm bush.	R1010-097
17:47:43	1523	103	45.93353	-129.98248	An overgrown MTR.	R1010-098
17:59:50	1523	103	45.93355	-129.98251	End of the measurement and are now retrieving the instrument.	
18:01:01	1523	103	45.93355	-129.98251	The table position after removal of pressure sensor.	R1010-099
18:02:33	1523	103	45.93356	-129.98251	The pressure sensor has been successfully recovered.	
18:07:51	1523	103	45.93355	-129.98253	We are changing the heading of the ship to see if it affects the navigation.	
18:11:09	1521	130	45.93349	-129.98252	At the **Mkr-33 vent**. There are 3 MTRs and a sulfide weathering experiment.	
18:11:37	1521	166	45.93350	-129.98245	Mkr 33 vents and observatory area.	R1010-100
18:12:45	1523	232	45.93346	-129.98236	Osmo meter; limpet cage; MTRs and several other experiments.	R1010-101
18:12:51	1523	243	45.93345	-129.98236	One of the limpet cages is here - Noreen's or Amanda's?	
18:14:32	1523	272	45.93343	-129.98236	A lot of flow is pouring through the cage. There are tubeworms growing on it.	
18:15:43	1523	204	45.93346	-129.98237	A shrimp floating by.	R1010-102
18:16:25	1523	163	45.93346	-129.98241	Another view of the Mkr 33 experiments.	R1010-103
18:16:28	1523	159	45.93346	-129.98241	Surveying around the vent area at Marker 33.	
18:18:50	1522	100	45.93345	-129.98242	A final view of Mkr 33.	R1010-104
18:19:37	1522	62	45.93342	-129.98239	This might be a good spot for the RAS. Especially if we remove the cage.	
18:21:50	1523	61	45.93343	-129.98238	Some nice DSCs and close up video was taken here.	
18:22:46	1522	1	45.93342	-129.98234	Moving on to Magnesia.	
18:23:55	1510	349	45.93375	-129.98239	Stopping the videos.	
19:23:33	1532	356	45.94548	-129.98511	We're still about 100 meters south of the target and heading north to Magnesia. The video is on.	
19:24:00	1532	356	45.94562	-129.98513	We're probably in the bottom of a collapse area here.	
19:24:15	1533	355	45.94569	-129.98513	Contact into jumbled flows.	
19:24:15	1533	355	45.94569	-129.98513	Contact between sheet and jumbled lava near Magnesia.	R1010-105

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
19:24:38	1531	355	45.94578	-129.98514	Sort of ropey lavas and a spectacular lava arch here.	
19:24:55	1532	355	45.94582	-129.98513	Natural arch with a light tan old bacterial mat on top (or could be sediments).	R1010-106
19:25:48	1529	4	45.94580	-129.98513	The top has a light tan color like there is some mat on the lobes on the top of this arch feature. Continuing north.	
19:26:07	1530	12	45.94582	-129.98513	A close up view of the bacterial mat (?) on top of the natural arch.	R1010-107
19:26:59	1530	317	45.94590	-129.98502	Spectacular solitary pillars poking up all over the place standing up in the collapse part of the flow.	
19:28:26	1525	352	45.94623	-129.98515	We should be fairly close to Magnesia now so we are looking around.	
19:30:13	1528	17	45.94634	-129.98530	We're at the target now - but don't see anything.	
19:30:39	1527	54	45.94634	-129.98530	We're going to head NE from the previous target. Seems to be offsets from our first pass south to our second pass going north.	
19:31:23	1528	50	45.94639	-129.98522	***There it is. Northeast is the way to go. We have a nav offset of 20 meters from our previous pass. It's consistent from the previous benchmarks.***	
19:31:52	1527	43	45.94641	-129.98513	We've sighted the **Magnesia benchmark** and are preparing to take the second pressure measurement.	R1010-108
19:33:48	1528	39	45.94643	-129.98504	We're at the benchmark now - sitting in front of it.	
19:37:13	1528	33	45.94643	-129.98505	We're grabbing the sensor and putting it on the benchmark.	
19:38:48	1528	33	45.94642	-129.98505	We're starting the measurement now.	
19:38:49	1528	33	45.94642	-129.98505	The instrument is set for the second pressure measurement at the Magnesia benchmark.	R1010-109
19:39:59	1528	33	45.94642	-129.98506	The measurement in progress.	R1010-110
19:40:19	1528	33	45.94642	-129.98506	Video stopped at 1938.	
19:59:45	1528	32	45.94642	-129.98506	We're ready to pick it up and move on.	
20:00:25	1528	32	45.94642	-129.98506	We are done with the second Magnesia measurement and are collecting the equipment.	R1010-111
20:00:33	1528	32	45.94642	-129.98506	The video is back on.	
20:01:40	1528	32	45.94642	-129.98506	Very nice stowage of the sensor.	
20:02:56	1528	32	45.94642	-129.98506	The sensor is stowed.	
20:03:22	1527	30	45.94642	-129.98506	The next benchmark is 2.1 kilometers away. This benchmark was Benchmark-1 at Magnesia. We are now heading to Benchmark 63 at the caldera center.	
20:05:30	1528	292	45.94662	-129.98545	A collapse pit with nice bathtub rings on the sides.	R1010-112
20:05:38	1528	280	45.94662	-129.98545	Amazing collapse pit in this lava flow.	
20:06:26	1524	281	45.94667	-129.98573	Stopped the video. We're leaving the bottom.	
20:07:16	1529	287	45.94669	-129.98600	Approaching a collapse pit with smooth lava drips visible on the sides.	R1010-113
20:07:27	1528	290	45.94668	-129.98601	That's the inside of a couple of lava lobes that are draining into the collapse pit.	
20:08:04	1528	296	45.94667	-129.98607	This pit has an odd pillar with a V shaped top.	R1010-114
20:08:06	1528	298	45.94667	-129.98607	It looks like it's a drip (that's a big drip)!	
20:08:21	1529	312	45.94666	-129.98611	A slightly closer view of this collapse pit.	R1010-115
20:08:31	1529	326	45.94665	-129.98612	Another view of the pit.	R1010-116
20:09:38	1529	329	45.94665	-129.98612	The lava pillar with strange smooth V shaped top. The lava may have dripped down and made contact with an existing pillar.	R1010-117
20:10:09	1529	329	45.94664	-129.98612	A close up view of the contact between the smooth upper V portion and the more typical lava pillar segment on the bottom.	R1010-118
20:10:59	1529	328	45.94664	-129.98612	Close up view of the crust with the smooth lava V attached.	R1010-119
20:11:40	1529	328	45.94664	-129.98612	Turned the video back on.	
20:12:03	1529	328	45.94664	-129.98612	Another shot of the underside of this collapse pit.	R1010-120
20:14:11	1529	305	45.94664	-129.98610	This lobe was most probably draining into the collapse pit. Or there was still molten lava in this lobe when the collapse happened. These look like they were partially molten on the wall when it collapsed.	
20:14:36	1529	265	45.94667	-129.98610	Lava flowing into the collapse pit. Could lava have oozed out due to a collapse of the overlying crust?	R1010-121
20:16:10	1529	258	45.94668	-129.98609	We're going to move on now. Really... We're in the water column.	
20:16:30	1528	282	45.94669	-129.98613	Video going off again.	
20:17:26	1529	352	45.94681	-129.98623	We're off the bottom.	
20:17:44	1527	346	45.94694	-129.98626	Now we're REALLY turning off the video.	
21:48:49	1532	281	45.95507	-130.00865	We're on the bottom here at the caldera center. Video went back on at 2149.	
21:49:48	1533	279	45.95504	-130.00859	We're just short of the caldera center. We're collecting a sediment sample for Dave on this flat lineated sheet flow into jar 6.	
21:50:39	1533	288	45.95504	-130.00859	Suction sediment #jar 6. Gravelly sediment on flat lineated sheet flow. Want to get a history of the lava flows here by looking at the chemistry of the glass fragments in the sediment. Z=1533. Caldera center. **R1010-SS-0001 (Clague)**	
21:51:42	1534	288	45.95504	-130.00859	We are collecting some sediment with the suction sampler.	R1010-122
21:55:22	1533	301	45.95506	-130.00872	A contact between lineated sheet flow and ropy sheet flow.	R1010-123
21:56:10	1533	292	45.95513	-130.00890	A circular pattern of ropy sheet flow.	R1010-124
22:00:39	1534	287	45.95535	-130.01004	This is probably the southern marker - south of the benchmark.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
22:01:03	1534	289	45.95537	-130.01009	There's the benchmark. Lining up to do the last pressure sensor measurement here at the caldera center (benchmark 63).	
22:03:48	1535	278	45.95542	-130.01015	We are at the caldera center and have located the marker for the second measurement.	R1010-125
22:05:28	1532	283	45.95541	-130.01015	We're off the bottom again.	
22:11:05	1535	281	45.95541	-130.01014	We're trying to position here. Still over the bottom.	
22:11:52	1525	15	45.95539	-130.01014	The vehicle is being pulled back by the cable so we're trying to figure what's going on.	
22:25:30	1535	310	45.95536	-130.01017	We ran out of DVCam tape earlier. Re-started with a new tape at 2227.	
22:27:59	1537	355	45.95535	-130.01021	Looks like we're OK now. Will put the pressure sensor on the benchmark now.	
22:29:28	1537	355	45.95535	-130.01021	Grabbing the sensor and placing it on the benchmark now.	
22:30:22	1537	355	45.95535	-130.01021	The 2nd pressure measurement at the caldera center begins.	R1010-126
22:30:22	1537	355	45.95535	-130.01021	Perfect placement. Starting the measurement now.	
22:30:38	1537	355	45.95535	-130.01021	Stopping the video now.	
22:33:29	1537	355	45.95535	-130.01021	We have no pressure signal right now so we're going to have to sort this out.	
22:38:35	1537	355	45.95535	-130.01021	Going to put it back in the holster and give Big Keith a call to see how we can cycle the power to the pressure sensor. Vinnie thinks we have to cycle power to the whole vehicle.	
22:39:58	1537	355	45.95535	-130.01021	The video is still off and will stay off for now.	
22:42:24	1537	355	45.95535	-130.01021	Contemplating what is wrong with it.	
22:44:35	1537	354	45.95535	-130.01021	We're retrieving the sensor and putting it in the holster. Will have to re-boot the sub for this. Sounds quite tricky.	
22:47:02	1537	354	45.95535	-130.01021	Stowing the sensor now.	
22:47:37	1537	354	45.95535	-130.01021	Keith says we should see what's going on with the umbilical first - then worry about the pressure sensor problem.	
22:49:53	1536	331	45.95534	-130.01018	We're going to deal with the umbilical first.	
23:01:19	1437	173	45.95322	-130.00753	We are still coming up to deal with the umbilical issue.	
23:14:14	1298	122	45.95525	-130.00945	Pressure sensor is alive again and the umbilical problem seems to be solved as well.	
23:28:10	1502	313	45.95672	-130.00865	We are almost back to the bottom to continue the survey.	
23:29:45	1537	315	45.95577	-130.00928	We are back on the bottom.	
23:33:30	1534	302	45.95573	-130.00973	Heading back to the benchmark in the center of the caldera.	
23:36:44	1536	196	45.95548	-130.00973	Passing over a collapsed lava flow.	
23:41:01	1535	1	45.95532	-130.00974	We are back at the benchmark. Settling down.	
23:45:28	1537	357	45.95533	-130.00973	Getting the pressure sensor into place.	
23:46:20	1537	357	45.95533	-130.00973	**Mid-caldera benchmark 63.**	R1010-127
23:47:01	1537	357	45.95533	-130.00973	**Starting pressure measurement.**	
23:47:40	1537	357	45.95533	-130.00973	Stopped the videos.	
0:05:07	1537	357	45.95540	-130.01018	Sea urchin here at the caldera center.	R1010-128
0:07:12	1537	357	45.95540	-130.01018	Stopping the measurement.	
0:08:46	1537	357	45.95541	-130.01020	Picking up the pressure sensor. Restarted the video.	
0:13:00	1537	357	45.95542	-130.01020	Pressure sensor is stowed.	
0:13:30	1537	357	45.95542	-130.01020	Lifting off and heading to Magnesia.	
0:14:25	1528	11	45.95539	-130.01019	Stopping videos. This will be the end of a DVD file. We will start a new file at Magnesia.	
1:57:10	1525	179	45.94660	-129.98529	Heading down to the bottom. Starting the videos.	
1:58:04	1527	160	45.94640	-129.98537	We have reached the bottom.	R1010-129
1:58:13	1527	86	45.94635	-129.98536	We are at the Magnesia marker.	R1010-130
1:58:14	1527	69	45.94635	-129.98536	And there it is! We found the marker at Magnesia.	
1:59:26	1525	40	45.94632	-129.98529	We are at the **Magnesia** marker.	R1010-131
2:03:36	1528	39	45.94632	-129.98529	Picking up the pressure sensor.	
2:06:06	1528	39	45.94632	-129.98529	We are setting down the instrument.	R1010-132
2:06:22	1528	39	45.94632	-129.98529	**The instrument is in place.**	R1010-133
2:08:50	1528	39	45.94632	-129.98529	Started measurement at 02:07. Stopping the videos.	
2:27:38	1528	39	45.94637	-129.98525	Stopping pressure measurement. Starting video recording.	
2:30:30	1528	39	45.94636	-129.98525	Stowing the pressure sensor.	
2:34:49	1528	39	45.94635	-129.98524	Sensor is secured. Moving 50 meters south to take a suction sample.	
2:39:35	1528	208	45.94586	-129.98560	Looking for a place to take a suction sample.	
2:40:00	1528	226	45.94584	-129.98562	Lava pillar south of Magnesia.	R1010-134
2:42:25	1531	180	45.94545	-129.98569	Sea bottom south of Magnesia.	R1010-135
2:44:18	1532	208	45.94514	-129.98572		R1010-136
2:44:24	1532	201	45.94515	-129.98572	There is much more sediment here on top of the jumbled flow.	
2:46:16	1534	227	45.94514	-129.98571	Settling down on a sheet flow with a lot of reddish sediment. Preparing to suction some of the sediment.	
2:50:10	1534	221	45.94514	-129.98572	We will try to sample the	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
2:50:44	1534	221	45.94514	-129.98572	Suction sample into jar #5. Grayish sediment down in the cracks and not the orange hydrothermal sediment. Z=1534. Location is 150 meters bearing 190 from Magnesia. **R1010-SS-0002 (Clague)**	
2:51:24	1534	221	45.94514	-129.98572	We are taking some suction samples close to Magnesia.	R1010-137
2:57:29	1534	220	45.94514	-129.98573	Suction sampling close to Magnesia.	R1010-138
2:58:16	1534	220	45.94514	-129.98573	Done suction sampling. Moving on to Marker 33 again.	
3:00:15	1526	163	45.94502	-129.98579	Stopped tapes recording.	
3:56:35	1517	173	45.93451	-129.98219	Back on the bottom heading to Marker 33.	
3:57:39	1518	173	45.93420	-129.98221	Video started on the approach.	
3:58:07	1518	172	45.93408	-129.98218	We are coming in from the north.	
3:58:36	1518	186	45.93401	-129.98220	We are about 50m away.	
4:00:51	1521	138	45.93368	-129.98223	Some garbage was spotted.	
4:00:59	1521	150	45.93369	-129.98220	Unidentified box near Marker 33.	R1010-139
4:01:41	1522	185	45.93367	-129.98213	Romaine lettuce box at bottom near Marker 33.	R1010-140
4:05:14	1522	341	45.93351	-129.98233	Dive weights on basalt near Mkr 33.	R1010-141
4:07:16	1523	304	45.93357	-129.98236	Weights and spider crab.	R1010-142
4:10:47	1522	228	45.93363	-129.98247	Preparing to suction for Jonathan Rose at **Marker-33**.	
4:10:54	1522	241	45.93362	-129.98246	Floating animate object (organism?) at Marker 33.	R1010-143
4:11:39	1523	243	45.93344	-129.98237	This limpet sample will be in hydrothermal flow.	
4:11:42	1523	247	45.93344	-129.98236	Marker 33.	R1010-144
4:12:36	1523	252	45.93343	-129.98236	Sulfide weathering experiment and limpet growth experiment at Marker 33.	R1010-145
4:17:04	1523	252	45.93343	-129.98238	Just flushed through jar 8. Rotating to jar 2 with 180 micron mesh.	
4:17:42	1523	252	45.93343	-129.98238	Suction into jar #2 (180 micron mesh). Limpets in hydrothermal flow. Z=1523. Mkr-33. **R1010-SS-0003 (Rose)**	
4:22:44	1523	270	45.93343	-129.98239	Suction sampling limpets off of the growth experiment cage.	R1010-146
4:27:47	1523	270	45.93335	-129.98244	Limpets in Jar 2.	R1010-147
4:28:12	1523	270	45.93335	-129.98245	Suction of limpets into jar #1 (180 micron mesh). The limpets are outside of the hydrothermal flow. Z=1523. Mkr-33. **R1010-SS-0004 (Rose)**	
4:34:58	1523	241	45.93333	-129.98247	End of suction samples.	
4:41:32	1523	239	45.93333	-129.98247	Some *A. galapagensis* seen waving around here.	
4:43:10	1523	239	45.93333	-129.98246	Amphisamytha flapping around.	R1010-148
4:45:15	1523	239	45.93333	-129.98246	Highlight tape turned on for the Amphisamytha.	
4:46:41	1523	239	45.93333	-129.98246	Scale worm and polychaete in shimmering water near Marker 33.	R1010-149
4:53:19	1523	190	45.93344	-129.98239	Recovering MTRs along the Marker 33 crack.	
4:54:30	1523	190	45.93345	-129.98239	**MTR 3291** has been grabbed and are putting back when one was just recovered. It is the western most MTR.	
4:58:16	1523	278	45.93341	-129.98231	At the eastern end of the crack - facing west.	
5:00:20	1523	262	45.93343	-129.98233	Setting down one of the MTRs recovered to grab another one.	
5:02:09	1523	264	45.93343	-129.98234	Grabbing **MTR #3045** from deep within the limpets.	R1010-150
5:02:16	1523	264	45.93343	-129.98234	Recovered MTR 3045.	
5:03:22	1523	264	45.93343	-129.98234	**Deploying MTR 3087** where MTR 3045 used to be (eastern end of the crack).	
5:04:01	1523	264	45.93344	-129.98234	Deploying MTR 3087 in the same spot one was recovered.	R1010-151
5:06:35	1523	246	45.93345	-129.98235	Sulfide weathering experiments will be taken up by the starboard manipulator.	
5:08:41	1523	246	45.93344	-129.98235	Moving the cage out of the flow to look for the MTR.	R1010-152
5:08:47	1523	246	45.93344	-129.98235	Lots of material on the cage.	R1010-153
5:09:10	1523	246	45.93345	-129.98234	The **growth experiment cage** has been moved aside in order to access the third MTR.	
5:10:25	1523	246	45.93345	-129.98234	A nice hole in the community where the cage once was located.	R1010-154
5:10:43	1523	246	45.93346	-129.98233	Close to the position where the cage was resting.	R1010-155
5:14:14	1523	246	45.93346	-129.98236	Can't find the third MTR.	
5:15:47	1523	246	45.93345	-129.98238	Looking through the 2004 NeMO cruise report to identify the spot where the MTR is placed.	
5:16:40	1523	246	45.93345	-129.98238	We are going to **deploy MTR 3201** where the growth experiment cage was originally placed (in the middle of the crack between the other two MTRs).	
5:19:53	1523	246	45.93345	-129.98237	The third MTR does not appear to be retrievable due to the presence of the osmo-sampler.	
5:21:36	1523	247	45.93346	-129.98236	The unretrieved MTR may have fallen in the crack.	
5:23:56	1523	247	45.93346	-129.98234	Two of the MTRs.	R1010-156
5:24:21	1523	251	45.93346	-129.98234	We have **recovered two MTRs deployed in 2004 (3039 and 3045) and deployed 3 (3291 3087 and 3201).** Couldn't find MTR 3026 that was deployed at the middle of the crack in 2004.	R1010-157
5:25:01	1522	331	45.93345	-129.98240	Tubeworm bush where another MTR is located.	R1010-158
5:26:10	1523	25	45.93348	-129.98248	Yellow poly rope from the MTR.	R1010-159
5:27:28	1523	24	45.93348	-129.98248	**Recovered the MTR 3196** from the tubeworm bush.	R1010-160
5:27:44	1523	24	45.93348	-129.98247	We have moved north west along the crack to a large tubeworm bush. MTR 3197 is being deployed inside the tubeworm bush.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
5:29:49	1523	24	45.93348	-129.98247	2004 MTR 3196 was recovered from the edge of the tubeworm bush.	
5:29:51	1523	24	45.93348	-129.98247	MTR 3197 deployed in the tubeworm bush.	R1010-161
5:31:05	1522	293	45.93353	-129.98246	Located benchmark at Marker 33.	
5:31:58	1523	108	45.93355	-129.98257	**At the Marker 33 benchmark (#5).**	R1010-162
5:35:39	1523	108	45.93355	-129.98257	Adjusting the **pressure sensor** on the benchmark.	
5:36:45	1525	107	45.93355	-129.98257	Start pressure measurement at 05:36.	
5:36:57	1523	107	45.93355	-129.98257	Placement of the pressure sensor.	R1010-163
5:41:27	1523	107	45.93355	-129.98257	DVCAM has been stopped.	
5:58:21	1523	107	45.93355	-129.98257	End of pressure measurement at 05:58. Recovering pressure sensor.	
5:59:15	1523	107	45.93355	-129.98257	DVD and DVCAM recorders turned on.	
6:01:31	1523	107	45.93355	-129.98257	Pressure sensor recovered.	R1010-164
6:02:54	1523	107	45.93355	-129.98257	Pressure sensor back on the ROPOS.	
6:05:55	1523	103	45.93355	-129.98258	DVD and DVCAM are turned off. Readjusting the pressure sensor in the ROPOS saddle.	
6:08:18	1523	103	45.93355	-129.98258	Pressure sensor is in place in the saddle. Beginning transect to Cloud. Video turned on.	
6:10:36	1522	94	45.93354	-129.98220	Driving east towards Cloud.	
6:13:07	1519	33	45.93351	-129.98179	Spotted settling plates indicating that we are near the vent.	
6:13:20	1520	2	45.93352	-129.98175	Near Cloud vent - some settling plates are to the left.	R1010-165
6:14:20	1523	355	45.93354	-129.98175	Cloud looks very different than in 2004.	
6:16:52	1520	335	45.93354	-129.98165	The hydrothermal flow at Cloud has deteriorated quite a bit in the past few years.	R1010-166
6:17:40	1523	272	45.93358	-129.98162	An area where some vent fauna remains.	R1010-167
6:18:07	1523	256	45.93359	-129.98163	Still a few tubeworms are around.	R1010-168
6:19:31	1524	210	45.93360	-129.98167	A little further around cloud vent.	R1010-169
6:21:42	1524	208	45.93360	-129.98167	Still a little cloudy around Cloud.	R1010-170
6:22:05	1525	199	45.93360	-129.98168	Presently in an area that is more similar to **Cloud** in 2004.	
6:24:41	1525	203	45.93359	-129.98169	Looking for a yellow polypro line attached to temperature recorders deployed here in 2004.	
6:27:06	1525	203	45.93359	-129.98169	We have identified the hole at Cloud but we can't find the polypro line (two MTRs attached together).	
6:28:36	1525	203	45.93359	-129.98169	We are referring to the 2004 log and frame grabs to find the original location of the MTRs.	
6:33:23	1524	270	45.93357	-129.98165	Readjusting heading and trying to find the chain-link anchor.	
6:49:44	1523	301	45.93359	-129.98163	We have relocated to a different hole that is right by the MTR. There are two holes at Cloud. The MTR is not by the array.	
6:49:47	1524	306	45.93359	-129.98164	Spotted the rope for the MTRs on the left.	R1010-171
6:50:24	1524	318	45.93359	-129.98167	This is the second hole at cloud vent. The anchor chain for the MTRs is visible.	R1010-172
6:50:58	1524	318	45.93359	-129.98169	This hole is right by the base of **Marker 69**.	
6:50:59	1524	318	45.93359	-129.98169	This is marker 69.	R1010-173
6:51:30	1524	318	45.93359	-129.98169	Pulling up the chain link anchor by the polypro line.	
6:51:56	1524	318	45.93359	-129.98169	Struggling to get the MTRs free.	R1010-174
6:52:41	1524	316	45.93359	-129.98169	Moving to get the MTRs again.	R1010-175
6:54:16	1524	315	45.93359	-129.98169	Pulling up a second line attached to a weight.	
6:54:40	1524	315	45.93359	-129.98169	An old weight or something pulled out from the hole.	R1010-176
6:54:56	1524	315	45.93359	-129.98169	We just pulled out a weight attached to a line here and put it back into the pit.	
6:56:07	1524	315	45.93359	-129.98169	The MTRS here at Cloud have been recovered. **3041 and 3054 have been recovered.** They were deployed in 2004.	
6:57:46	1524	309	45.93359	-129.98169	We are recovering the MTRs.	R1010-177
7:00:36	1524	305	45.93359	-129.98169	We're deploying 2 MTRs here in the small hole at Cloud Vent **at the base of Mkr-69. Deploying MTRS 3185 and 3312** (with floats numbered 52 and 04 respectively).	
7:05:32	1524	305	45.93359	-129.98169	We are about to put the MTR in the pit.	R1010-178
7:05:34	1524	305	45.93359	-129.98169	The two MTRS are bundled together and will be placed in the pit where the other 2 were.	
7:09:56	1524	318	45.93359	-129.98169		R1010-179
7:10:06	1524	318	45.93359	-129.98169	Dropping MTRs 3185 and 3312 in the smaller pit at the base of Mkr-69. The anchor chain in placed off to the side of the pit. Our heading is 317 looking at the pit.	
7:10:27	1524	318	45.93359	-129.98169	The MTRs are in the pit.	R1010-180
7:12:12	1524	313	45.93359	-129.98169	View of the MTR configuration in the small pit at the base of Marker 69 - here at Cloud Vent.	R1010-181
7:12:46	1524	311	45.93359	-129.98169	View of the MTR configuration in the small pit at the base of Marker 69 - here at Cloud Vent.	R1010-182
7:13:07	1524	303	45.93359	-129.98169	We're taking a series of DSCs and Frame grabs so that we can locate these temp recorders the next time we return to collect them.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
7:14:19	1524	293	45.93359	-129.98167	View of the MTR configuration in the small pit at the base of Marker 69 - here at Cloud Vent.	R1010-183
7:14:35	1524	293	45.93359	-129.98167	We're on our way to Castle next. The transit will be about 45 minutes.	
7:15:23	1523	298	45.93359	-129.98167	We are leaving Cloud to head on Castle.	R1010-184
7:17:12	1522	172	45.93351	-129.98168	Stopped the video at 0716.	
8:01:37	1519	122	45.92631	-129.98024	Start video at 0801. In the area of Castle sulfide chimney. Looking around. Don't see it yet.	
8:03:37	1518	49	45.92642	-129.98014	Big pillows in this area.	R1010-185
8:03:59	1519	53	45.92641	-129.98008	We're here at the **Castle** Anhydrite.	R1010-186
8:04:43	1520	51	45.92642	-129.98007	We're going to replace this hobo with another. We're also going to grab a piece of anhydrite chimney and put it in the biobox.	
8:05:50	1520	77	45.92645	-129.98007	We're going to recover hobo 152 first.	
8:06:53	1520	79	45.92645	-129.98007	Took several DSCs of the area. **Retrieving hobo 152 from the anhydrite chimney** now.	
8:07:22	1520	79	45.92645	-129.98007	The hobo is number 152.	R1010-187
8:07:30	1520	79	45.92645	-129.98007	Another shot.	R1010-188
8:07:41	1520	79	45.92645	-129.98007	The hobo is sticking in the side of the chimney and there is hot water coming up right below. Looks good.	R1010-189
8:08:44	1520	83	45.92645	-129.98007	Bacterial mat covering the hobo stem.	R1010-190
8:09:47	1520	82	45.92645	-129.98007	Recovering hobo 152 deployed in 2004.	R1010-191
8:10:13	1520	88	45.92645	-129.98007	It's a bit cemented in there. It should come out. The chimney broke. That was really in there.	
8:10:51	1520	97	45.92646	-129.98007	Pulling the hobo probe (#152) out of the chimney.	R1010-192
8:13:26	1520	103	45.92646	-129.98008	The hobo doesn't want to fit in the biobox.	
8:14:06	1520	103	45.92646	-129.98008	Grabbing Miso 102 to deploy in the anhydrite chimney here. The Misos are the new generation of hobos.	
8:16:32	1520	105	45.92646	-129.98008	Having a bit of a problem picking up the replacement hobo (miso).	
8:17:23	1520	105	45.92646	-129.98008	Got it out of the box. Now what?	
8:18:23	1520	105	45.92646	-129.98008	Setting the new miso down on the ground for now.	
8:18:28	1520	105	45.92646	-129.98008	We are about to deploy a hobo (miso) in the anhydrite chimney at Castle.	R1010-193
8:20:21	1520	105	45.92646	-129.98008	We're discussing how to get a piece of this anhydrite for Francoise. Knocked the top off.	
8:21:36	1520	105	45.92646	-129.98008	The top of the chimney just fell. We are taking it for sample.	R1010-194
8:22:58	1520	105	45.92646	-129.98008	The chimney after the top came off when we removed the 2004 hobo. Preparing to **deploy hobo (miso) 102 in the anhydrite at Castle.**	R1010-195
8:23:20	1520	105	45.92646	-129.98008	There's lots of flow coming out of the chimney. Trying to stick the tip of the probe into the chimney.	
8:25:26	1520	105	45.92646	-129.98008	Trying to stick the probe straight down into the chimney. It doesn't really have enough of a bend in it to deploy it any other way.	
8:25:45	1520	105	45.92646	-129.98008	Attempts to deploy miso #102.	R1010-196
8:26:33	1520	105	45.92646	-129.98008	Attempts to deploy miso #102.	R1010-197
8:26:41	1520	105	45.92646	-129.98008	Looks like Keith had it in the chimney - maybe not.	
8:28:21	1520	105	45.92646	-129.98008	Ok looks like Keith has it. That looks perfect. Miso probe 102 is in there.	
8:28:44	1520	105	45.92646	-129.98008	The probe is deployed. Miso 102 is in the anhydrite orifice at Castle sulfide chimney.	R1010-198
8:30:56	1521	22	45.92641	-129.98004	The top of the chimney. A piece of this will be a sample for Francoise.	R1010-199
8:33:25	1521	31	45.92641	-129.98004	The top of the chimney we just took out as a sample.	R1010-200
8:33:31	1521	31	45.92641	-129.98004	This chimney top is much more solid than it appeared. May be able to get the whole piece.	
8:34:38	1521	39	45.92641	-129.98005	A piece of the anhydrite chimney. Placed in the boot. It broke into 2 pieces. Z=1521. Castle anhydrite. **R1010-RK-0005 (Labonte)**	
8:38:28	1521	39	45.92641	-129.98005	We are going to leave this part here and come back in a few days to recover it.	R1010-201
8:39:22	1521	34	45.92641	-129.98006	We're going to look at the hobo (miso) in the vent. Still there.	
8:39:50	1521	21	45.92640	-129.98005	Hobo (miso) 102 after deployment in the anhydrite vent at Castle.	R1010-202
8:40:24	1521	339	45.92642	-129.97999	Hobo (miso) 102 after deployment in the anhydrite vent at Castle.	R1010-203
8:40:43	1520	338	45.92643	-129.98000	There's blue mat right up the structure from the hobo.	
8:41:27	1520	332	45.92643	-129.97998	This is **Castle** and it looks like a Castle. We're going to look around a bit. The top spires are covered in mat. It's from the plume water that's flowing over it.	
8:41:29	1520	328	45.92643	-129.97998	**Castle: a huge chimney!**	R1010-204
8:42:19	1513	34	45.92643	-129.98007	Towards the top of Castle sulfide chimney.	R1010-205
8:43:44	1514	59	45.92647	-129.98010	What are the orange patches on this? Might be an iron oxidizing bacteria?	
8:43:52	1514	60	45.92647	-129.98010	Bacterial mats and...	R1010-206
8:44:16	1514	51	45.92647	-129.98009	Filamentous bacterial mat and something orange - could be a sponge or iron-fixing bacterial mat?	R1010-207
8:45:27	1514	73	45.92647	-129.98011	A good look at the filamentous bacterial mat on a Castle spire.	R1010-209

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
8:46:07	1515	101	45.92647	-129.98012	It really does look like a castle.	
8:48:00	1520	340	45.92643	-129.98000	We're looking at a very small patch of blue mat here. It's not worth suctioning.	
8:48:50	1520	341	45.92643	-129.97999	We see Craig Moyer's bacteria traps here. They're black.	
8:48:54	1520	341	45.92644	-129.97999	Bacteria traps.	R1010-210
8:49:57	1520	309	45.92646	-129.97997	We're going to try to suction this blue mat into jar 3. It seems to be growing in this crack. Also see tubeworms and limpets growing along the crack in the chimney.	
8:50:52	1519	297	45.92647	-129.97998	Limpets and blue mats at Castle.	R1010-211
8:52:36	1519	315	45.92649	-129.97998	Have to drop the Gucci purses before suctioning.	
8:53:28	1520	313	45.92647	-129.97999	Blue mat and other biota next to old; dead bacterial traps.	R1010-212
8:53:57	1520	311	45.92646	-129.98000	We will sample into jar 3 (200 micron mesh).	
8:54:27	1520	309	45.92646	-129.98001	We are going to sample in jar 3 the blue mats for Angela.	R1010-213
8:56:18	1520	291	45.92646	-129.98000	The blue mats bush has been moved by the vacuum.	R1010-214
8:58:16	1520	299	45.92646	-129.98001	Angela has decided that she would rather have a suction than grab the blue mat and tubeworm clump.	
8:59:26	1520	310	45.92646	-129.98001	Blue mats and other biota at Castle.	R1010-215
9:00:52	1519	317	45.92646	-129.98001	Suction blue mat (ciliates) into jar #3 (200 micron mesh). It's obvious the blue mats are exposed to the flow and receiving fluids from the vents. Z=1519. Castle. **R1010-SS-0006 (Kouris)**	
9:05:45	1519	285	45.92647	-129.98001	We're finished sampling here and will pick up the purses and head out to Village.	
9:08:33	1520	300	45.92647	-129.98001	Grabbed tubeworm clump with blue mat (ciliates). The clump was above the anhydrite chimney. Lots of ciliates among the tubeworms. Z=1520. Castle. **R1010-bio-0007 (Kouris)**	
9:08:34	1520	300	45.92647	-129.98001	Grabbing the tubeworm clump with blue mat (ciliates).	R1010-216
9:09:23	1520	294	45.92647	-129.98000	Angela's blue mats.	R1010-217
9:12:07	1519	247	45.92645	-129.98015	We are moving out of Castle and heading to Village.	R1010-218
9:14:04	1520	304	45.92642	-129.98041	Coming upon Village.	R1010-219
9:14:46	1521	219	45.92650	-129.98048	We are at **Village**. We see some blue mats. The logging computer has issues. We replace the laptop logging computer with one that actually has a bit of memory. Thank you.	R1010-220
9:15:41	1521	263	45.92649	-129.98056	Tubeworms and bluemat at Village.	R1010-221
9:16:15	1522	262	45.92650	-129.98058	Tubeworms are very healthy here.	R1010-222
9:16:35	1522	272	45.92649	-129.98058	The gills of the tubeworms are very visible here.	R1010-223
9:17:43	1522	328	45.92648	-129.98057	We're setting down the purses again and preparing to sample blue mat here at Village vent.	
9:17:48	1523	322	45.92648	-129.98057	We are putting down sulfide purses.	R1010-224
9:20:18	1523	293	45.92646	-129.98057	This looks like the edge of a lava pillar with bathtub rings.	
9:20:55	1523	293	45.92646	-129.98057	We're going to flush jar 8 - then sample more mat into jar 4 with 200 micron mesh.	
9:23:23	1523	294	45.92646	-129.98057	We are going to take the suction sample of Angela's bluemats.	R1010-225
9:23:47	1523	294	45.92646	-129.98057	Just knocked the blue mat off the substrate.	
9:25:24	1523	280	45.92646	-129.98056	We're looking at this spectacular site. Finding the best place to sample.	
9:25:31	1523	278	45.92646	-129.98056	Tubeworm bush off to the left.	R1010-226
9:26:10	1523	300	45.92645	-129.98057	Probably the sampling site... Tubeworms are visited by the syntactic foam.	R1010-227
9:26:37	1522	303	45.92645	-129.98057	There's a lot of biomass in the water.	
9:30:59	1523	314	45.92644	-129.98059	The arm of the ROPOS in the tubeworms...	R1010-228
9:32:50	1523	334	45.92644	-129.98059	Blue mats.	R1010-229
9:33:57	1523	341	45.92643	-129.98060	The blue mat tends to fall and disappear when we suction it.	
9:34:32	1523	336	45.92644	-129.98059	Suction blue mat into jar #4 (200 micron mesh). When we try to grab a mat-encrusted rock it keeps crumbling. Went for a suction instead of a rock grab. Z=1523. Village. **R1010-SS-0008 (Kouris)**	
9:34:50	1523	331	45.92644	-129.98059	Broken rock.	R1010-230
9:37:10	1522	331	45.92646	-129.98058	Perfect spot with bluemats at Village.	R1010-231
9:39:07	1523	340	45.92646	-129.98058	bluemats...	R1010-232
9:40:26	1523	340	45.92646	-129.98058	Limpets and bluemats here at Village.	R1010-233
9:42:14	1523	341	45.92646	-129.98059	We have finished sampling the blue mat here.	
9:42:19	1523	341	45.92646	-129.98058	We've got the bluemats! Ye!	R1010-234
9:42:37	1523	341	45.92646	-129.98058	Don't forget your purses Keith. The substrate here is very fragile. Wants to break apart.	
9:44:13	1523	318	45.92648	-129.98056	Checking the gauges before taking off for Vixen at Coquille vent field.	
9:46:27	1522	179	45.92650	-129.98055	1.4 km at a bearing of 223 degrees.	
9:47:12	1522	229	45.92644	-129.98060	We are leaving Village and heading to Vixen.	R1010-235
9:47:40	1522	223	45.92640	-129.98064	This is Diffuse-Village. Wacky tubeworm bush on the top of a solitary pillar.	
9:48:42	1521	233	45.92635	-129.98070	Lava pillars leaving Village.	R1010-236
9:48:47	1521	232	45.92635	-129.98070	Pillars and collapse pits in this area. Now traveling over lobate flows.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
9:51:35	1521	209	45.92601	-129.98126	Hobbit hole.	R1010-237
9:51:52	1521	210	45.92600	-129.98129	Collapse pit in this lobate lava flow.	
9:53:09	1520	198	45.92585	-129.98148	Stopping the video now.	
9:55:44	1522	198	45.92575	-129.98150	Small anemone out away from the vents.	R1010-238
10:50:05	1497	218	45.91933	-129.99030	We're still traveling in the water column to Vixen where we will drop off 2 hobos.	
11:05:08	1534	223	45.91756	-129.99273	We are back on the bottom heading to Vixen.	
11:06:06	1535	257	45.91755	-129.99297	A shallow collapsed lobe seen shortly after we touched bottom near Vixen.	R1010-239
11:06:09	1536	257	45.91755	-129.99298	Pillow lavas with collapsed portions.	
11:07:02	1535	257	45.91761	-129.99309	We are starting to see bunches of tubeworms.	R1010-240
11:07:40	1535	307	45.91768	-129.99306	Lots of venting around and tons of floc in the water.	
11:09:52	1536	226	45.91765	-129.99311	Still searching for Vixen.	
11:10:51	1536	197	45.91763	-129.99320	There are some good sized tubeworm bushes here. Heading southwest on the search for Vixen.	
11:11:09	1536	205	45.91763	-129.99318	Here is another look at some of the tubeworms.	R1010-241
11:13:31	1535	123	45.91757	-129.99315	We have moved out of the venting area back into more pillow lavas.	
11:16:56	1535	239	45.91755	-129.99324	More tubeworms. We are getting closer to the site.	R1010-242
11:17:43	1535	231	45.91748	-129.99331	We are still searching around the nav target looking for Vixen.	
11:18:33	1535	209	45.91740	-129.99337	Found **Vixen**. We will recover 2 Hobos and leave 2 Misos for later deployment.	
11:19:19	1537	220	45.91737	-129.99337	At Vixen and looking at a yellow staining near the vents.	R1010-243
11:19:32	1537	214	45.91737	-129.99337	Here is a small chimney with a mounded base.	R1010-244
11:20:01	1537	214	45.91737	-129.99337	This chimney has 2 types of deposits at the base. The white is probably anhydrite.	R1010-245
11:22:21	1536	182	45.91733	-129.99337	Spotted one hobo in the vent with the marker. Other hobo is likely behind the smoke.	
11:23:17	1534	118	45.91729	-129.99341	Here is the vent with the hobo. It's marker 57.	R1010-246
11:24:48	1535	91	45.91726	-129.99339	Marker is number 57.	
11:27:06	1536	359	45.91723	-129.99332	This is Hobo 153.	
11:27:09	1536	337	45.91724	-129.99330	Here are the hobo instruments at the mounded base of Vixen vent.	R1010-247
11:27:14	1536	327	45.91725	-129.99329	The vent with the hobos through a cloud of particulates.	R1010-248
11:28:00	1537	318	45.91725	-129.99331	A zoomed in view of the vent with the hobos.	R1010-249
11:28:05	1537	318	45.91725	-129.99331	Here is another close up view of the vent with the hobos.	R1010-250
11:28:26	1537	318	45.91725	-129.99331	Hobo 153 is right in the hot water. The other Hobo is more off to the side and somewhat buried in the mound.	
11:30:25	1537	318	45.91727	-129.99333	Picking up the Misos to leave here before recovering the 2 Hobos.	
11:32:09	1537	317	45.91727	-129.99332	Heading is 317 and Misos 101 and 103 are sitting off the port side on the SW side of the small vent with marker 57 in it.	
11:34:48	1537	317	45.91727	-129.99332	**Recovered Hobo 153.** The end is all crusted with what may be Chalcopyrite.	
11:35:38	1537	317	45.91727	-129.99332	The end of the first hobo probe we removed has some kind of deposit at the end. It is chalcopyrite.	R1010-251
11:37:35	1537	275	45.91733	-129.99334	**Hobo 128 recovered** from same vent with marker 57.	
11:41:53	1537	306	45.91731	-129.99335	Deploying the Misos now. Miso 101 is in the vent.	
11:44:11	1537	305	45.91731	-129.99335	We are inserting the Misos into the same vent we removed the hobos from.	R1010-252
11:46:55	1537	299	45.91731	-129.99335	Trying to stab the second Miso into the base at the side of the mound.	
11:46:59	1537	299	45.91731	-129.99335	We are trying to stab a hobo (miso) into the side of the mound	R1010-253
11:47:56	1537	297	45.91731	-129.99335	We are placing the same probe that was intended for the side of the mound into the flow out of the mound.	R1010-254
11:48:36	1537	297	45.91731	-129.99335	Retrieving a dropped probe.	R1010-255
11:49:28	1537	297	45.91731	-129.99335	Dropped the Miso. Picking it up and trying to insert it again. Need to get the tip as vertical as possible to get down in.	
11:50:11	1537	297	45.91731	-129.99335	We are inserting the secondary probe to better track the flow over time.	R1010-256
11:51:30	1537	273	45.91731	-129.99335	Gave up and left Miso right in front of the marker at heading 270.	
11:51:36	1537	263	45.91732	-129.99335	We have inserted the probe in front of the marker.	R1010-257
11:52:13	1536	217	45.91735	-129.99336	A view of the **deployed Miso and the one left for later deployment.**	R1010-258
11:52:22	1535	245	45.91734	-129.99334	Heading off to Bag City now.	
11:52:24	1535	268	45.91733	-129.99333	We are now leaving Vixen en route to Bag City.	R1010-259
11:52:30	1535	291	45.91732	-129.99332	A last view of the area around Vixen.	R1010-260
11:53:40	1534	55	45.91740	-129.99327	We will be traveling 250m at 110 to Bag City.	
12:09:05	1534	96	45.91654	-129.98961	Back on the bottom near Bag City. Looking for the benchmark.	
12:11:18	1533	152	45.91654	-129.98948	Shallow collapse pit in lobate lava.	R1010-261
12:11:27	1534	175	45.91654	-129.98948	Collapsed pits in lobate flow.	
12:12:23	1535	121	45.91649	-129.98955	The edge of a collapse pit.	R1010-262
12:13:57	1534	95	45.91644	-129.98949	Another collapse pit.	R1010-263
12:15:50	1534	107	45.91659	-129.98939	Lava pillar.	R1010-264
12:15:57	1534	182	45.91661	-129.98936	Large collapsed pit here with some pillars.	

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
12:18:47	1535	306	45.91644	-129.98941	Still searching for the Bag City marker. Passing over several collapsed pits.	
12:18:47	1535	306	45.91644	-129.98941	We are still looking for Bag City.	R1010-265
12:20:08	1534	342	45.91659	-129.98942	A lava pillar.	R1010-266
12:21:06	1535	8	45.91666	-129.98939	Another lava pillar.	R1010-267
12:24:38	1534	195	45.91653	-129.98983	We are sweeping around to the north and west of the Bag City nav target in search of venting.	
12:25:09	1534	160	45.91641	-129.98977	The top of a lava pillar.	R1010-268
12:25:51	1534	158	45.91637	-129.98975	Patches of tubeworms ahead but no marker yet.	
12:26:19	1533	145	45.91633	-129.98975	We have found an area of venting. The benchmark must be nearby.	R1010-269
12:26:49	1533	188	45.91627	-129.98980	We found the **benchmark at Bag City**.	
12:28:11	1532	257	45.91620	-129.98976	We are now at the benchmark **and marker 65**.	R1010-270
12:29:35	1534	38	45.91617	-129.98988	Settling down to take the **pressure measurement**.	
12:31:55	1535	39	45.91618	-129.98986	Picking up the pressure sensor.	
12:33:46	1535	41	45.91617	-129.98986	We are placing the pressure sensor upon the benchmark.	R1010-271
12:34:46	1535	41	45.91618	-129.98986	Started measurement 12:33. Stopping videos.	
12:35:03	1535	41	45.91618	-129.98988	Frame grab of situated pressure sensor to supplement data due to difficulties with the DSC camera.	R1010-272
12:37:21	1535	41	45.91621	-129.98986	DSC is misbehaving. Cycling power to the camera. Feed did not come back.	
12:46:27	1535	41	45.91631	-129.98982	DSC is back up again but it is being fussy.	
12:48:24	1535	41	45.91631	-129.98982	Tried to point the DSC straight down again and it will not take a photo there. The cable may be being tugged.	
12:50:29	1535	41	45.91631	-129.98982	Lost DSC feed again.	
12:53:59	1535	41	45.91637	-129.98981	Stopped the pressure measurement. Videos are back on.	
12:55:08	1535	41	45.91636	-129.98979	We are removing the pressure sensor and getting ready to move on to the next site.	R1010-273
12:57:04	1535	41	45.91635	-129.98979	Pressure sensor is stowed. Going to take a suction sample of sediment here.	
13:00:11	1533	177	45.91641	-129.98974	Circling around to find a good spot to suction sediments.	
13:00:45	1534	175	45.91639	-129.98977	Site of suction sample to procure volcanic glass particles off the flow surface into jar 7.	R1010-274
13:01:11	1534	175	45.91639	-129.98978	We are just north of the benchmark. Putting down the purses so we can use the suction hose.	
13:02:57	1534	175	45.91638	-129.98975	Flushing into jar 8.	R1010-275
13:03:53	1534	175	45.91637	-129.98975	Suction sample into jar #7. Light sediment covering on lavas. Repositioned once to get more sediment. Z=1534m. ~3m north of the Bag City benchmark. **R1010-SS-0009 (Clague)**	
13:05:04	1534	175	45.91638	-129.98976	Taking suction sample.	R1010-276
13:11:57	1534	175	45.91647	-129.98976	We are discussing the best way to get a good suction sample at this location.	
13:12:50	1534	175	45.91647	-129.98980	We are looking for a better location to gather more of the glass particles that Dave wants.	R1010-277
13:13:17	1534	175	45.91647	-129.98980	We are picking up the purse and moving forwards a short distance to get more sediment with the suction hose.	
13:15:52	1535	233	45.91644	-129.98983	Slightly to the left of additional site of suction sample to increase volume of sediment collected.	R1010-278
13:17:09	1534	229	45.91644	-129.99001	Collecting sediment into jar 7 at second suction sample site to increase sample volume.	R1010-279
13:21:09	1534	226	45.91644	-129.98987	Done suction sampling. Going back to pick up the purses.	
13:22:02	1535	197	45.91647	-129.98990	We are retrieving purses which were set down near the benchmark to facilitate the suction sample.	R1010-280
13:23:26	1535	197	45.91647	-129.98990	We have the purses. Heading down to the southern-most benchmark.	
13:24:26	1534	160	45.91640	-129.98984	We have retrieved the purses and are leaving Bag City and en route to last pressure sensor site.	R1010-281
13:25:21	1536	130	45.91620	-129.98952	A lava pillar.	R1010-282
13:27:54	1533	197	45.91598	-129.98954	Stopped video recording.	
13:28:38	1536	197	45.91586	-129.98960	A lava pillar connected at the top.	R1010-283
17:31:12	1722	170	45.86477	-130.00345	Back on the bottom - starting the video recordings.	
17:32:06	1721	168	45.86456	-130.00339	We are 130m NE of the benchmark. So this is likely 1998 pillow lava we are passing over.	
17:34:42	1725	186	45.86395	-130.00345	It looks like we are out of the 1998 flows and are into the older regions.	
17:41:26	1725	174	45.86373	-130.00407	Waiting for the Thompson to settle into a decent position.	
17:49:29	1723	148	45.86364	-130.00379	A sponge.	R1010-284
17:54:01	1723	223	45.86372	-130.00427	A basket star or something similar.	R1010-285
18:02:34	1723	93	45.86341	-130.00380	We have found the benchmark.	
18:02:57	1722	86	45.86343	-130.00371	Benchmark spotted in the distance.	R1010-286
18:05:37	1723	12	45.86342	-130.00354	Preparing to deploy the pressure sensor one last time.	
18:08:50	1723	12	45.86342	-130.00354	The pressure sensor is in place.	R1010-287

Time	Z	Hdg	raw lat	raw long	R1010 Comments: Pressure Dive (Axial)	FrGrab
18:08:52	1723	12	45.86342	-130.00354	Starting the pressure measurement at the **South Pillow Mound benchmark**. Stopping the video.	
18:19:52	1723	12	45.86348	-130.00363	Position of the pressure sensor for the last measurement.	R1010-288
18:30:24	1723	12	45.86346	-130.00358	Finished with pressure sample.	
18:31:42	1723	12	45.86346	-130.00358	Video is being recorded again as we recover the pressure sensor.	
18:32:55	1723	19	45.86345	-130.00359	The sub moves at the same time the transducer is removed.	R1010-289
18:37:48	1723	21	45.86345	-130.00362	Attempting to see if the sulfide weathering experiment tubes will fit in the biobox.	
18:40:10	1723	21	45.86346	-130.00363	The experiment has been stowed successfully.	
18:43:15	1723	172	45.86341	-130.00369	***Stopping video for the dive. The Thompson is spinning its heading to allow for some navigation checks.***	
19:18:27	1723	173	45.86339	-130.00376	Finished with acoustic nav test. ROPOS off bottom. End of dive.	
20:35:09	7	286	45.86354	-130.00451	ROPOS at the surface.	
20:37:44	2	243	45.86357	-130.00449	ROPOS on deck. End of ROPOS dive R1010. The new record for a dive: > 53 hours.	

5.6.4 R1011 - Northern ’98 Lava Flow (Axial)

R 1011 Northern 1998 lava flow. [R1011 Bottom time: 9/1 1618 - 9/2 0141 (9 hrs 23 min)] Fluid sampling on the northern/mid section of the 1998 lava flow, and RAS deployment at Mkr-33. The dive started at Forum where fluid sampling began. Saw a line of diffuse venting as headed south - some on and around pillars like Forum. Sampled blue mat (ciliates) and water at Mkr-N3 site. Noticed diffuse venting at the edge of some collapse pits along the way. Found a large eruptive fissure, probably from the 1998 flow, between Mkr-N3 and Mkr-33 sites. Looked at the rumbleometer that has been down since 1998. Found the 2006 RAS sampler and deployed it at Marker-33 vent first sampling the area, recovering 1 limpet cage and 1 MTR. Moved on to Cloud for sampling. *Performed another nav offset test by spinning the ship.* 20 samples total. Enroute to Forum: 1 HFS for background DNA. Forum: 3 HFS, 1 gas. Between Forum and Mkr-N3: 1 SS of seds for glass. Mkr-N3: 3 HFS, 1 McLane, 1SS of blue mat, 1 biogeo grab of blue mat. 10 m from Mkr-N3: 1 SS of seds for glass. Mkr-33: 4 HFS, 1 gas, 1 McLane. Cloud: 1 SS of limpets.

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern ’98 Lava Flow (Axial)	FrGrab
15:06:39	0	0	45.86357	-130.00449	ROPOS is going in the water.	R1011-001
15:06:39	0	0	45.86357	-130.00449	ROPOS is in the water.	
15:24:00	0	0	45.86357	-130.00449	ROPOS is clear to dive.	
16:18:17	1526	270	45.94661	-129.98443	On the bottom.	
16:20:34	1522	286	45.94658	-129.98440	Heading to Forum vent. DVCAM started and DVD at 1:10.	
16:21:08	1524	283	45.94658	-129.98440	ROPOS reached the bottom.	R1011-002
16:21:51	1528	283	45.94656	-129.98434	Here are some lava pillars.	R1011-003
16:21:54	1528	283	45.94658	-129.98433	Some nice pillars in this area.	
16:23:37	1526	264	45.94667	-129.98439	Sterivex #24 filter to get the background DNA. Tmax=2.5°C; Tavg=2.4°C; T2=2.4°C; Vol=1261ml End time=16:38. It is starting and stopping a lot. Z=1526. Collected while en-route to Forum. It was stopped as we arrived at Forum. **R1011-HFS-0001 (Butterfield)**	
16:26:06	1526	287	45.94674	-129.98445	We are looking for the Forum vent near Magnesia.	R1011-004
16:26:46	1524	160	45.94664	-129.98435	Trying to find the Forum vent site. There are two nav fixes due to some offsets in the system. It is the only active vent in this region.	
16:29:08	1525	204	45.94644	-129.98424	The benchmark has been spotted.	
16:29:49	1526	207	45.94646	-129.98425	Here is the Magnesia bench mark.	R1011-005
16:34:06	1526	78	45.94651	-129.98411	This is another lava pillar at **Magnesia**.	R1011-006
16:37:00	1526	81	45.94655	-129.98379	Some hydrothermal sediments spotted. We must be getting warm.	
16:37:50	1526	73	45.94657	-129.98364	The vent **Forum** spotted. There are some tubeworms.	
16:38:27	1524	66	45.94658	-129.98357	We arrived at Forum vent.	R1011-007
16:40:01	1526	101	45.94662	-129.98345	Positioning at Forum vent to get samples.	
16:41:23	1529	111	45.94662	-129.98341	Here are some tube worms at the vent Forum.	R1011-008
16:41:28	1529	111	45.94662	-129.98341	Quite a bit of flow at Forum. Highlights tape has been turned on.	
16:42:33	1529	111	45.94662	-129.98340	Here are some limpets and maybe some snails on a lava pillar.	R1011-009
16:43:47	1529	111	45.94661	-129.98340	Getting ready to sample.	
16:44:58	1529	111	45.94662	-129.98340	Here are some tube worms.	R1011-010
16:46:22	1529	111	45.94662	-129.98339	Here are some Palm worms.	R1011-011
16:47:45	1529	111	45.94661	-129.98340	Looks like a little anhydride chimney at the top of the venting area here.	
16:53:06	1529	111	45.94659	-129.98343	We are positioning to sample the water at the vent.	R1011-012
16:56:35	1529	111	45.94661	-129.98341	ROPOS is grabbing the water filter.	R1011-013
17:06:02	1529	111	45.94660	-129.98341	HFS Filtered bag #7. Tmax=91.2°C; Tavg=74.4°C; T2=50°C; Vol=464ml; End time=17:09.50. Z=1529. Forum Vent. **R1011-HFS-0002 (Butterfield)**	
17:06:12	1529	111	45.94660	-129.98341	They are starting to sample the water.	R1011-014
17:08:59	1529	111	45.94660	-129.98341	Gas tight bottle #15. Tmax=91.2°C; Tavg=74.4°C; T2=50°C. Z=1529. Forum Vent. **R1011-gas-0003 (Evans)**	
17:12:23	1529	111	45.94660	-129.98341	HFS Unfiltered Piston #1. Tmax=83.7°C; Tavg=80.5°C; T2=50°C; Vol=800ml. End time=17:17.14. Z=1529. Forum Vent. **R1011-HFS-0004 (Butterfield)**	
17:18:40	1529	111	45.94633	-129.98399	HFS DNA filter #23. Tmax=92.6°C; Tavg=83.4°C; T2=50°C; Vol=2162ml. End time=17:34. Z=1529. Forum Vent. **R1011-HFS-0005 (Butterfield)**	
17:35:25	1529	111	45.94630	-129.98397	End of sampling at Forum.	
17:36:31	1529	111	45.94632	-129.98394	Hopping up to the edge of the collapse where Forum is located.	
17:36:55	1527	104	45.94632	-129.98392	Here are some lava pillars near Forum. Notice the bacterial mat at the base of the pillars.	R1011-015
17:41:06	1525	178	45.94615	-129.98392	Heading to Marker N3.	
17:47:48	1519	196	45.94612	-129.98361	ROPOS is going to N3.	R1011-016
17:47:57	1519	199	45.94610	-129.98362	There looks to be a long line of vents here. The vents are similar to the one sampled down inside the collapsed pit (Forum).	
17:49:12	1522	196	45.94590	-129.98372	A crab on a lava pillar.	R1011-017
17:52:12	1525	198	45.94548	-129.98388	Stopping to take a suction sample for glass fragments.	
17:54:30	1527	191	45.94546	-129.98386	Suction sediment for glass fragments - into Jar #5 (1mm mesh). Between Forum and Marker-N3 Vent ~200m N of N3). Z=1527. **R1011-SS-0006 (Clague)**	

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
17:55:28	1527	191	45.94546	-129.98386	ROPOS is sampling sediments.	R1011-018
17:57:32	1527	191	45.94546	-129.98386	Suctioning sediment on the 1998 Lava Flow.	R1011-019
18:07:22	1526	209	45.94388	-129.98511	Just coming into the area of Marker N3.	
18:07:58	1528	238	45.94382	-129.98519	Blue mats in the area of Marker-N3 vent site.	R1011-020
18:08:00	1528	234	45.94382	-129.98520	Lots of blue mat in the area.	
18:09:41	1527	213	45.94373	-129.98518	Lots of material in a collapsed area. Blue mats; tube worms and other animals.	
18:10:27	1526	156	45.94372	-129.98512	At marker 52 currently (Marker 52 replaced N3 after that disappeared).	
18:11:13	1527	258	45.94369	-129.98502	ROPOS is now at marker 52. We are seeing blue mats at this marker.	R1011-021
18:12:47	1526	334	45.94360	-129.98512	Another view of the blue mats (ciliates).	R1011-022
18:12:49	1526	335	45.94360	-129.98513	The blue mats are extremely abundant in this area.	
18:14:12	1525	359	45.94357	-129.98516	Here are some tube worms and blue mats.	R1011-023
18:17:39	1530	350	45.94363	-129.98517	Still moving around the **N3 site** to find a good location to sample.	
18:24:28	1530	14	45.94363	-129.98518	We are looking for a good water sampling area.	R1011-024
18:25:03	1530	14	45.94362	-129.98518	The water sampler wand is out and we are testing a little vent to potentially sample here.	
18:25:22	1530	14	45.94363	-129.98518	We are testing a vent for water sampling.	R1011-025
18:34:19	1530	12	45.94365	-129.98517	HFS filtered bag #8. Tmax=24.3°C; Tavg=23.3°C; T2=18°C; Vol=510ml; End time=18:37. Z=1529. Mkr-N3 area. **R1011-HFS-0007 (Butterfield)**	
18:35:59	1530	12	45.94364	-129.98518	Blue mats at the sampling site.	R1011-026
18:36:39	1530	12	45.94364	-129.98517	This is a close view of the blue mats.	R1011-027
18:37:26	1530	12	45.94364	-129.98517	This is a close view of a tube worm.	R1011-028
18:39:17	1530	12	45.94364	-129.98517	HFS Unfiltered Piston #2. Tmax=24.7 °C; Tavg=24.4 °C; T2=18 °C; Vol=800 ml; End time=1845. Z=1530. Mkr-N3 area. **R1011-HFS-0008 (Butterfield)**	
18:45:48	1530	11	45.94364	-129.98516	We'll do another water sample and then start a filter.	
18:47:51	1530	11	45.94364	-129.98515	HFS unfiltered bag #13. Tmax=24.6 °C; Tavg=24.3 °C; T2=17.5 °C; Vol=524 ml; End time=1851. This was later logged as a sample (#13). Mkr-N3 area. **R1011-HFS-0013 (Butterfield)**	
18:53:30	1530	11	45.94365	-129.98517	This is a pretty picture of the blue mat while setting up to take a high volume sample.	R1011-029
18:53:44	1530	11	45.94365	-129.98517	We're setting up to take a high volume filter.	
18:54:14	1530	11	45.94364	-129.98516	Starboard McLane filter sample. Start 1854. Stop 1855:45.	
18:55:00	1530	11	45.94365	-129.98516	A close-up of the blue mat.	R1011-030
18:56:17	1530	11	45.94364	-129.98518	Another close-up of the blue mat.	R1011-031
19:01:53	1530	11	45.94364	-129.98517	Finished fluid sampling. Now will look around for a place to sample the blue mat - which is everywhere here.	
19:03:28	1530	11	45.94363	-129.98519	Will do a suction sample into jar 3 (200 micron double mesh).	
19:04:59	1530	11	45.94364	-129.98519	Starboard McLane filter sample. Start 1854. Stop 1855:45. 19.5 liters. Tavg=24.7. Stable temperature. Z=1530. Mkr-N3 area. **R1011-McLane-0009 (Bolton)**	
19:05:28	1530	11	45.94364	-129.98520	Sampling the blue mat.	R1011-032
19:05:57	1530	11	45.94364	-129.98519	Suction sample blue mat (ciliates) into jar #3 (200 micron double mesh). Large patch of blue mat sampled. Start 1905. Stop 1913. Z=1530. Mkr-N3 area. **R1011-SS-0010 (Kouris)**	
19:07:04	1530	11	45.94364	-129.98519	Sampling blue mat.	R1011-033
19:07:42	1530	11	45.94363	-129.98519	Sample jar 3 after sampling.	R1011-034
19:10:36	1530	11	45.94364	-129.98518	Sampling some more blue mat.	R1011-035
19:12:22	1530	10	45.94364	-129.98518	Sample jar after sampling.	R1011-036
19:13:47	1530	10	45.94363	-129.98516	Flushing jar #8.	
19:14:07	1530	10	45.94363	-129.98516	We're looking for a rock so that we can get a colony of blue mat (relatively undisturbed).	
19:15:10	1530	10	45.94363	-129.98515	Sampling a rock with blue mat.	R1011-037
19:16:17	1529	16	45.94363	-129.98515	This area has some lava pillars as well. The bathtub rings are evident here.	
19:17:03	1530	15	45.94362	-129.98516	Bathtub rings on a lava pillar.	R1011-038
19:17:33	1529	10	45.94363	-129.98516	We're going to move out of the tubeworm area. This is a huge area of blue mat. The marker was about 5+ meters from the sample site.	
19:19:39	1525	232	45.94370	-129.98511	Setting down to look at another area of blue mat.	R1011-039
19:20:25	1527	184	45.94371	-129.98516	Beautiful blue mat roof on this small collapse cave.	
19:23:03	1528	178	45.94370	-129.98514	Sampling a rock with blue mat.	R1011-040
19:23:51	1528	180	45.94370	-129.98514	The area of sampling.	R1011-041
19:24:56	1528	130	45.94368	-129.98516	We are going to sample on this site. We will break off a piece of rock with blue mat.	
19:25:09	1528	130	45.94368	-129.98516	Trying again to sample a rock with blue mat.	R1011-042
19:25:34	1528	133	45.94368	-129.98515	Grabbed 2 pieces of rock ledge with lots of blue mat (ciliates). Looks like the blue mat was attached to a surface area and lots slipped off during sampling. Placed in the purse. Z=1528. Mkr-N3 area. **R1011-biogeo-0011 (Kouris)**	
19:26:47	1528	133	45.94367	-129.98515	Securing the sample.	R1011-043

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
19:28:57	1528	134	45.94370	-129.98513	We're going to get a temperature reading in the blue mat next.	
19:30:42	1528	135	45.94369	-129.98514	Getting a temperature recording in the blue mat.	R1011-044
19:32:31	1528	135	45.94368	-129.98515	Temp readings in the blue mat: 2.7°C; 2.9°C; 2.8°C. She's finished.	
19:33:43	1528	136	45.94367	-129.98515	Temperature probing in the blue mat.	R1011-045
19:35:41	1529	131	45.94367	-129.98515	Taking a bunch of DSCs here and a few frame grabs.	
19:36:17	1528	131	45.94368	-129.98515	Close-up of the blue mat.	R1011-046
19:37:26	1528	131	45.94369	-129.98514	The area of blue mat that we have been sampling.	R1011-047
19:38:08	1523	179	45.94368	-129.98512	We're heading to Marker 33 through the water column. We're 10 meters away from the blue mat site. We will get a suction sample of the surface of the basalt here.	
19:39:21	1530	202	45.94347	-129.98507	Suction sediments into jar #4 (200 micron double mesh). Will serve as a control for Angela's blue mat studies. Start 1943 Stop 1944:30. Z=1530. There are no mat in this non-venting area ~10 m away from the last sample at N3. **R1011-SS-0012 (Kouris)**	
19:43:07	1531	148	45.94354	-129.98504	Suction sampling "background" site to compare with blue mat.	R1011-048
19:45:07	1531	148	45.94352	-129.98505	We were 10 meters away from the last sample site - but about 2-3 meters away from blue mat (scarce compared to what we saw before).	
19:45:15	1531	148	45.94352	-129.98505	Blue mat near the background sample site - about 3 meters away.	R1011-049
19:47:56	1520	174	45.94267	-129.98488	We're now on our way to Marker 33 site. The bottom is in sight. Collapse area beneath us.	
19:49:18	1520	172	45.94230	-129.98477	Collapse pit in this area of jumbled lava.	R1011-050
19:49:53	1518	171	45.94218	-129.98472	Pillars; arches and collapse area.	R1011-051
19:50:36	1519	169	45.94209	-129.98466	Another pillar complex in this area of jumbled collapse.	R1011-052
19:52:03	1520	171	45.94189	-129.98457	Lobate flows here.	R1011-053
19:54:24	1519	168	45.94155	-129.98437	Another collapse feature with bacterial mat on lobate flows.	R1011-054
19:54:34	1519	169	45.94152	-129.98435	There are patches of bacterial mat around these lobate lavas on the edge of this collapse.	
19:55:14	1519	185	45.94144	-129.98434	Another collapse pit.	R1011-055
19:55:42	1517	184	45.94135	-129.98439	There's obviously some diffuse flow in the area - intermittent bacterial mat.	
19:57:25	1518	177	45.94110	-129.98439	Bathtub rings on the side of a collapse feature.	R1011-056
19:57:43	1520	176	45.94107	-129.98438	A close-up of the bathtub rings.	R1011-057
19:57:58	1519	175	45.94102	-129.98437	Taking some DSCs of what looks like the eruptive fissure right here. Vinnie put down a nav target: **Fissure N/NW**. It's a very deep fissure here.	
19:58:28	1518	175	45.94093	-129.98435	We are traveling down the fissure that we found.	R1011-058
19:59:36	1520	176	45.94078	-129.98430	Pillars with bathtub rings.	R1011-059
19:59:38	1519	172	45.94077	-129.98430	Lava roof and very deep fissure in this area.	
20:00:29	1517	206	45.94065	-129.98431	More of the fissure.	R1011-060
20:00:50	1517	177	45.94058	-129.98433	Traveling down the fissure.	R1011-061
20:00:55	1516	178	45.94056	-129.98432	There's a huge deep crevice in this area that is **probably one of the main eruptive fissures in the '98 flow.**	
20:01:27	1517	184	45.94048	-129.98435	The fissure.	R1011-062
20:01:46	1517	176	45.94043	-129.98438	It's a very narrow linear fissure here.	
20:02:04	1518	177	45.94040	-129.98438	The fissure widens and has rubble at its bottom.	R1011-063
20:02:16	1519	177	45.94037	-129.98438	Now it's widening out. Looks like it's had a lot of back flow here. Beautiful; pillars at the edge of this collapse.	
20:02:31	1519	168	45.94032	-129.98436	Pillars and roofs in this collapse area.	R1011-064
20:02:58	1518	159	45.94024	-129.98428	Collapse roof.	R1011-065
20:04:40	1518	170	45.93987	-129.98425	Back in the lobate flows.	R1011-066
20:07:34	1518	171	45.93939	-129.98400	Still moving south toward Marker 33.	
20:09:05	1518	172	45.93921	-129.98392	Traveling along this not quite as interesting area of lobates and collapse pits.	
20:09:28	1518	170	45.93912	-129.98389	A single pillar.	R1011-067
20:09:45	1518	169	45.93907	-129.98386	The edge of a collapse.	R1011-068
20:10:06	1518	168	45.93902	-129.98382	Lava pillar in collapse basin.	R1011-069
20:10:26	1518	165	45.93896	-129.98378	Over a collapse area here with solitary pillars popping up here and there. Rubble on the seafloor.	
20:12:11	1518	168	45.93866	-129.98355	A collapse area with lave pillars.	R1011-070
20:13:38	1519	168	45.93842	-129.98350	Still traveling over this area of lobate flows on the edges; pillars and bath tub rings and collapse area in the middle. Jumbled lavas in the collapse area.	
20:15:13	1518	159	45.93815	-129.98333	A lava arch.	R1011-071
20:17:11	1519	169	45.93777	-129.98325	Inside this collapse area - the floor is a pile of jumbled rubble.	R1011-072
20:17:49	1519	165	45.93767	-129.98320	We're on the floor of the collapse area here. These lavas are a combination of ropey and jumbled.	
20:20:49	1521	182	45.93715	-129.98326	We're approaching the place where the rumbleometer is sitting.	
20:23:26	1519	177	45.93672	-129.98323	We're close to the area where the rumbleometer is in the flow.	
20:24:13	1519	80	45.93661	-129.98322	We are at the rumbleometer.	R1011-073

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
20:24:16	1519	75	45.93662	-129.98321	There's the **rumbleometer that has been out here for years (since 1998)** and forgotten until Bill looked into it in 2004.	
20:25:36	1517	254	45.93672	-129.98299	The rumbleometer site.	R1011-074
20:25:51	1518	266	45.93669	-129.98300	Taking a bunch of DSCs.	
20:26:01	1519	262	45.93670	-129.98302	Position of the rumbleometer.	R1011-075
20:26:14	1519	260	45.93669	-129.98303	Close-up of the rumbleometer.	R1011-076
20:29:12	1519	243	45.93672	-129.98308	Position of the rumbleometer.	R1011-077
20:32:00	1521	242	45.93677	-129.98303	Switching out the video tape at 2033.	
20:36:23	1521	238	45.93670	-129.98303	Finishing up here - poking and prodding the rumbleometer.	
20:38:00	1522	240	45.93667	-129.98304	The rumbleometer frame.	R1011-078
20:38:00	1522	240	45.93667	-129.98304	Poked at it and it does move. Shouldn't be too hard to get it off the bottom.	
20:39:32	1517	172	45.93630	-129.98294	We're moving on to Marker 33 site for more fluid sampling.	
20:41:22	1519	182	45.93560	-129.98259	Collapse feature.	R1011-079
20:48:40	1518	185	45.93443	-129.98250	We have sighted the bottom again and are still traveling over collapse features.	R1011-080
20:49:21	1518	185	45.93434	-129.98251	Lava arch.	R1011-081
20:50:51	1518	183	45.93417	-129.98251	We're close to the bottom again.	
20:52:00	1518	183	45.93403	-129.98250	A collapse feature with visible bathtub rings.	R1011-082
20:53:27	1519	172	45.93384	-129.98239	Collapse wall with bacterial mat on it.	R1011-083
20:53:36	1519	172	45.93382	-129.98238	Looks like some scattered patches of bacterial mat in this area.	
20:58:07	1520	168	45.93359	-129.98228	Looking for the RAS mooring. The homer is not working.	R1011-084
20:58:27	1518	267	45.93350	-129.98226	The homer is not working?? dang. Looking around for the RAS mooring.	
20:59:33	1522	215	45.93336	-129.98233	We have reached a benchmark.	R1011-085
21:00:08	1523	196	45.93330	-129.98237	We're at the benchmark just north of Marker 33.	
21:04:29	1516	187	45.93323	-129.98237	Stopped the video at 2103 while we're in the water column looking for the RAS floats.	
21:07:54	1522	181	45.93303	-129.98233	We're searching for the RAS in the area of Marker 33.	
21:11:00	1520	64	45.93291	-129.98207	ROPOS has found the RAS.	R1011-086
21:11:01	1520	62	45.93291	-129.98206	We found it. We're going to release the drop anchor and move it over to Marker 33 vent.	
21:11:26	1523	85	45.93297	-129.98200	Preparing to remove the drop anchor.	R1011-087
21:13:02	1524	162	45.93305	-129.98197	Looks like a piece of plumbing hanging out of the bottom of the RAS.	
21:14:05	1524	158	45.93304	-129.98197	One cylinder tube is hanging below the bottom of the instrument.	R1011-088
21:15:04	1524	158	45.93306	-129.98197	Looking at the anchor on the bottom. The crabs have found it already and are crawling on it.	
21:15:48	1524	161	45.93304	-129.98197	Anchor weight of the RAS.	R1011-089
21:20:11	1524	162	45.93303	-129.98197	Releasing drop anchor.	R1011-090
21:20:19	1524	162	45.93303	-129.98197	Just released the drop anchor.	
21:20:38	1524	162	45.93303	-129.98196	We'll head to Marker-33 vent now. We're less than 50 meters away.	
21:22:35	1523	166	45.93304	-129.98199	On the move with the RAS.	
21:25:42	1522	186	45.93320	-129.98240	We're approaching Marker 33. Looks like the tubeworm bush near the benchmark.	
21:27:44	1521	106	45.93319	-129.98235	Approaching Mkr 33.	R1011-091
21:28:42	1522	115	45.93319	-129.98233	Mkr 33.	R1011-092
21:29:32	1521	100	45.93319	-129.98225	Other venting at Mkr 33.	R1011-093
21:31:17	1522	112	45.93325	-129.98224	We've put the RAS down so that we can go and work at the vent a bit. Will deploy it when we're finished sampling here.	
21:31:35	1521	145	45.93323	-129.98228	Mkr-33.	R1011-094
21:31:52	1523	149	45.93320	-129.98225	**Mkr-33 RAS 2006 site.**	R1011-095
21:32:30	1524	163	45.93318	-129.98222	2006 RAS site at Mkr 33.	R1011-096
21:34:11	1524	201	45.93319	-129.98222	We're moving the limpet cage out of the way so that we can get in there.	
21:34:49	1524	199	45.93318	-129.98223	Noreen had labeled the limpet's shells originally. Wanted to know how they grew etc..	
21:35:12	1524	199	45.93318	-129.98223	Moving the limpet cage.	R1011-097
21:35:59	1524	199	45.93318	-129.98223	The MTR is attached to the limpet cage. There it is. The missing MTR was attached to the limpet cage. Looks like we will be able to recover the MTR and limpet cage together.	
21:36:14	1524	199	45.93318	-129.98223	ROPOS has found the MTR that we couldn't find on the last dive. This one was deployed in 2004. **Recovered on this dive (MTR 3026).**	R1011-098
21:36:51	1524	199	45.93318	-129.98224	We have moved the limpet box with the MTR out of the way.	R1011-099
21:37:23	1524	199	45.93318	-129.98228	We're looking at the osmosampler tube now. It goes down into the crack - obviously.	
21:37:26	1524	199	45.93318	-129.98228	Osmo sampler tube enters the crack here.	R1011-100
21:39:11	1524	199	45.93319	-129.98228	We're going to do lots of fluid sampling next.	
21:39:48	1524	199	45.93319	-129.98228	Moving the HFS so that we can get at the RAS sampling cone.	R1011-101

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
21:40:06	1524	199	45.93320	-129.98226	Grabbing the intake and laying it down. Next are going to grab the RAS sampling dome (cover).	
21:42:34	1524	199	45.93323	-129.98219	Trying to manipulate the dome cover.	
21:43:07	1524	199	45.93324	-129.98218	Preparing to place the sampling cone.	R1011-102
21:44:20	1524	199	45.93324	-129.98216	There is a message on the chain links that the engineers or ROPOS group left. It's always something.	
21:44:52	1524	199	45.93324	-129.98216	Placing the cone.	R1011-103
21:45:22	1524	194	45.93324	-129.98216	Placing the sampling cone (dome).	R1011-104
21:46:42	1524	191	45.93323	-129.98218	Trying to level out the dome (cone).	
21:48:29	1524	191	45.93320	-129.98221	Moving the cone just to the left.	R1011-105
21:49:01	1524	190	45.93319	-129.98223	Repositioned the dome again. The MTR that was deployed on the last dive (mid-crack) is right next to the dome.	
21:50:45	1524	190	45.93317	-129.98223	That looks better. Pushed MTR 3201 to the right a bit. Looks like lots of flow coming out of the top of the dome.	
21:50:46	1524	190	45.93317	-129.98223	**RAS sampling cone in place.**	R1011-106
21:52:46	1524	190	45.93318	-129.98221	Placing the RAS MTR (#3043) in the RAS dome hole. Looks good now.	
21:52:56	1524	190	45.93318	-129.98221	Placing the MTR in a sample cone hole.	R1011-107
21:53:19	1524	190	45.93318	-129.98221	MTR in place.	R1011-108
21:55:15	1524	190	45.93318	-129.98223	Preparing to take fluid samples with the beast in a hole in the RAS dome.	
21:56:07	1524	190	45.93319	-129.98225	Checking out the temperature in the hole in the dome.	
21:57:47	1524	190	45.93321	-129.98226	17.5°C and falling. Moving the nozzle now. Going up a bit to 19.2°C.	
21:59:38	1524	190	45.93321	-129.98226	Going to poke around in the crack a bit and see what we get there. Decided to try the other hole first.	
22:01:10	1524	190	45.93321	-129.98226	Probing temperatures around the cone (6°C).	R1011-109
22:01:10	1524	190	45.93321	-129.98226	Took the wand out of the dome and poking it directly in the crack. Poking it farther down 4°C. Not real hot.	
22:01:43	1524	190	45.93321	-129.98226	Probing for temperature around cone (4°C).	R1011-110
22:03:15	1524	190	45.93318	-129.98223	Probing temperature around cone (5°C).	R1011-111
22:03:51	1524	190	45.93318	-129.98223	Moving down the crack to the area of more diffuse flow and tubeworms.	
22:04:55	1524	204	45.93319	-129.98222	More temperature probing.	R1011-112
22:05:35	1524	204	45.93320	-129.98223	Probing temperature (17.5 deg-C).	R1011-113
22:05:38	1524	204	45.93320	-129.98223	Temp is at 12C and increasing to 17.5C right next to the MTR. The sensor end of the MTR is pointing away from the hot water. We'll flip it around later.	
22:07:00	1524	204	45.93320	-129.98223	Probing temperature (13.9 deg-C).	R1011-114
22:08:00	1524	204	45.93320	-129.98223	Looks like the whole MTR is in hot water.	
22:08:35	1524	204	45.93319	-129.98223	Probing for temperature (20.2C).	R1011-115
22:08:43	1524	204	45.93319	-129.98223	The temp at the other end of the MTR is 18C; 20C; 20.2.	
22:09:38	1524	204	45.93319	-129.98228	Going to go back and take a water sample out of the cover.	
22:12:50	1524	204	45.93320	-129.98227	Temp is 14°C in the hole in the dome. 13C now. Moving the dome around.	
22:15:49	1524	204	45.93322	-129.98229	Moving the DSC files.	
22:16:45	1524	204	45.93322	-129.98229	Sliding the dome around a bit trying to get a higher temp in the hole.	
22:17:19	1524	204	45.93322	-129.98229	Moved it a bit and it seems to be going up. 17°C.	
22:18:26	1524	204	45.93322	-129.98229	Temperature is 18 C now.	R1011-116
22:19:14	1524	204	45.93321	-129.98225	Dave thinks this looks good. The temp is creeping up.	
22:21:18	1524	204	45.93318	-129.98222	HFS filtered bag #9 in the RAS dome hole. Temp range is 18°-19C. Doesn't appear to be working. Tmax=19.2°C; Tavg=18.6°C; T2=13.2°C; Vol=608ml; End time=2224 Z=1524. Probably didn't work. Mkr-33. **R1011-HFS-0014 (Butterfield)**	
22:25:36	1524	204	45.93319	-129.98225	HFS filtered bag #10. Tmax=18.9°C; Tavg=18.3°C; T2=13.0°C; Vol=586 ml; End time=2229. Z=1524. This one is working. Mkr-33. **R1011-HFS-0015 (Butterfield)**	
22:27:39	1524	204	45.93319	-129.98225	Gastight #11. Temp=17.8°C. In same area as previous (present) HFS sample #14. Z=1524. Mkr-33. **R1011-gas-0016 (Evans)**	
22:31:53	1524	204	45.93319	-129.98225	HFS unfiltered piston #3. Tmax=18.5°C; Tavg=18.0°C; T2=13.0°C; Vol=711 ml; End time=2236. Z=1524. Mkr-33. **R1011-HFS-0017 (Butterfield)**	
22:35:13	1524	204	45.93319	-129.98225	Switched the video tape.	
22:37:22	1524	204	45.93319	-129.98225	HFS Sterivex filter #17. Tmax=18.6°C; Tavg=18.0°C; T2=13.0°C; Vol=2033 ml; End time=2253. Z=1524. Mkr-33. **R1011-HFS-0018 (Butterfield)**	
22:41:09	1524	204	45.93319	-129.98222	Raphael is telling Dave where to put the camera now. We're looking around Marker-33 area.	
22:43:48	1524	204	45.93319	-129.98222	Looks like a little bit of blue mat here too.	
22:44:01	1524	204	45.93319	-129.98222	The possibility of a little bit of blue mat here.	R1011-117
22:52:40	1527	204	45.93318	-129.98225	We're sitting here looking around while Dave takes the sterivex large-volume filter sample.	
22:54:22	1524	204	45.93318	-129.98225	High volume McLane sample. Temp=17-18°C during sampling. Vol=20.7 liters. End time=2258. Z=1524. Mkr-33. **R1011-McLane-0019 (Bolton)**	
22:59:37	1524	204	45.93319	-129.98222	Stowing the intake now.	

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
23:00:06	1524	204	45.93318	-129.98222	**Next task is to deploy the RAS.**	
23:02:04	1524	204	45.93318	-129.98225	Going to place marker 55 here. Hopefully this one will not disappear.	
23:05:14	1524	204	45.93318	-129.98231	Reattaching a bungee on the purse.	
23:05:28	1524	204	45.93318	-129.98231	Going back to pick up the RAS for deployment.	
23:08:01	1524	143	45.93324	-129.98220	Picking up the RAS anchor and heading back to the vent.	
23:10:40	1521	177	45.93324	-129.98224	We have placed the new marker and are now carrying the RAS to the vent.	R1011-118
23:12:32	1524	158	45.93318	-129.98223	Placing the RAS anchor down at the eastern end of the crack at Marker 33 (aka marker 55 now).	
23:16:50	1522	115	45.93317	-129.98227	Going to release the intake line from the side of the RAS.	
23:21:03	1520	174	45.93319	-129.98222	The RAS near the vent.	R1011-119
23:21:51	1521	180	45.93318	-129.98221	Trying to get some digitals of the top and underside of the RAS. There is a bit of tubing hanging out the bottom that should not be there.	
23:24:34	1522	61	45.93313	-129.98225	We are looking at a tube hanging down from the bottom of the RAS.	R1011-120
23:25:14	1522	88	45.93315	-129.98226	Still deciding how to grab onto the RAS frame to pull the intake line free.	
23:27:20	1522	144	45.93320	-129.98226	RAS intake hose is free. Taking it down to the vent cover.	
23:28:05	1523	156	45.93321	-129.98225	A look at the underside of the RAS.	R1011-121
23:32:18	1524	207	45.93326	-129.98220	Positioning the intake for the RAS in the vent cover.	
23:32:34	1524	207	45.93326	-129.98220	We are placing the RAS intake into the vent cover.	R1011-122
23:33:27	1524	197	45.93326	-129.98220	RAS is deployed in the vent cover.	
23:34:50	1524	197	45.93326	-129.98220	There is concern that the line to the intake hose is too tight. We will back away and have a look.	
23:35:19	1524	194	45.93326	-129.98220	We think the line is a little tight so we are moving the anchor over.	R1011-123
23:36:26	1522	188	45.93328	-129.98217	Going to pick up the anchor and move it slightly closer to the vent.	
23:40:44	1523	197	45.93326	-129.98218	Moved the anchor about a meter closer to the vent and the intake line looks better.	
23:40:49	1523	191	45.93327	-129.98218	Here is better picture of the hose hanging down from the RAS.	R1011-124
23:43:39	1524	208	45.93319	-129.98222	Close up view of the vent cover after the final placement of the RAS.	R1011-125
23:44:52	1524	174	45.93320	-129.98225	Pivoting around to have a look at the area and the vent cover and take some digital photos.	
23:46:16	1523	128	45.93319	-129.98228	The vent cover from a different angle.	R1011-126
23:47:10	1523	131	45.93320	-129.98229	RAS looks good. Going to pick up the limpet cage now and head to Cloud.	
23:47:34	1521	174	45.93323	-129.98225	Overview of the area with the new marker and RAS.	R1011-127
23:48:23	1524	253	45.93317	-129.98216	Stopping to pick up the cage and take it with us.	R1011-128
23:51:12	1524	246	45.93319	-129.98219	Recovered the limpet cage and MTR 3026. Backing away a bit to pull off the MTR and stow it.	
23:54:41	1524	181	45.93323	-129.98223	Shaking tubeworms off the MTR.	R1011-129
23:58:02	1524	180	45.93323	-129.98223	Using the port arm to scrape off the bunch of tubeworms before putting the MTR in the purse.	
23:58:15	1524	180	45.93323	-129.98223	We pulled most of the tubeworms off the MTR rope.	R1011-130
0:01:40	1524	181	45.93323	-129.98223	We have to move the fluid sampler intake line to get the MTR in the purse.	
0:03:51	1524	180	45.93321	-129.98219	MTR is in the purse. Stowing the fluid sampler wand again.	
0:06:24	1523	169	45.93322	-129.98217	Going to grab the limpet cage by the hockey pucks on the side rather then carrying it by the lid.	
0:12:23	1524	186	45.93329	-129.98209	We have the limpet cage by the pucks and are now heading to Cloud.	
0:13:00	1520	185	45.93330	-129.98208	Started a new DVD volume.	
0:18:17	1521	130	45.93344	-129.98160	Marker dead ahead.	
0:19:18	1523	148	45.93339	-129.98152	We are at **Cloud** marker 69.	
0:20:38	1522	248	45.93338	-129.98141	Cloud Pit.	R1011-131
0:20:58	1524	273	45.93335	-129.98142	Cloud pit with the MTRs in it.	R1011-132
0:21:28	1525	287	45.93335	-129.98144	Settling down at the pit with the MTR in it to do some fluid sampling.	
0:25:59	1526	26	45.93332	-129.98149	Arrived at Cloud, removed the beast intake out and are recording temperature values.	
0:30:08	1526	21	45.93332	-129.98148	We are taking a temperature reading with the wand.	R1011-133
0:32:02	1526	26	45.93332	-129.98149	Still looking for the highest temperature flow out of Cloud.	
0:40:13	1526	28	45.93332	-129.98149	Trying to work out an issue with the pump on the water sampler. It was working initially but stopped.	
0:43:45	1526	28	45.93332	-129.98149	The water sampler is not working so we will proceed with a suction sample for limpets.	
0:45:10	1526	28	45.93332	-129.98149	We are flushing into jar 8.	R1011-134
0:50:11	1526	27	45.93329	-129.98160	We are still looking for a place to sample limpets.	
0:52:09	1526	27	45.93330	-129.98163	Bacterial mats growing upon tubeworms near Cloud.	R1011-135
0:54:27	1526	357	45.93327	-129.98160	Suction sample into Jar #1 (180 micron filter). Suctioning limpets off of the tubeworms at the edge of the pit. Relocated mid sample to find more limpets. Z=1526. Cloud. **R1011-SS-0020 (Rose)**	
0:55:00	1526	358	45.93327	-129.98159	We are suctioning limpets off of the tubeworms.	R1011-136
0:58:17	1526	317	45.93330	-129.98158	We are moving to find another site to collect more limpets.	R1011-137

Time	Z	Hdg	raw lat	raw long	R1011 Comments: Northern '98 Lava Flow (Axial)	FrGrab
1:02:16	1525	145	45.93313	-129.98167	We are still searching for another site to continue sampling limpets.	R1011-138
1:03:01	1525	145	45.93310	-129.98167	Suctioning another group of limpets to add to the same sample and increase biomass.	R1011-139
1:08:54	1525	139	45.93301	-129.98168	We are suctioning more limpets to increase the biovolume of the sample.	R1011-140
1:10:19	1525	139	45.93301	-129.98168	Still suctioning limpets.	
1:14:04	1525	139	45.93301	-129.98168	We are still suctioning limpets.	R1011-141
1:15:12	1525	140	45.93301	-129.98168	Done suction sampling.	
1:17:54	1523	110	45.93301	-129.98169	Lifting off the bottom. We may go get a sediment suction sample before ending the dive.	
1:18:05	1522	111	45.93301	-129.98169	We are on our way to our next location.	R1011-142
1:20:46	1519	295	45.93307	-129.98191	***We are going to do the ship spin to check the nav offset.***	
1:21:26	1520	312	45.93316	-129.98207	Lava pillar.	R1011-143
1:21:32	1520	319	45.93317	-129.98209	Lava pillars.	R1011-144
1:21:37	1520	348	45.93319	-129.98212	Lava pillar.	R1011-145
1:24:09	1521	343	45.93331	-129.98218	We are settled on the bottom and the ship will do a clockwise rotation.	
1:34:20	1521	354	45.93370	-129.98221	Ship is still doing its twisty spinney thing.	
1:36:07	1521	355	45.93370	-129.98221	Bringing the limpet cage in to rest on the front of the vehicle for ascent.	
1:40:09	1521	356	45.93366	-129.98222	***Done with the nav offset test. Leaving the bottom.***	
1:40:33	1520	13	45.93367	-129.98221	One last view of a lava pillar as we leave the area.	R1011-146
2:45:52	72	276	45.93326	-129.98159	Football floats coming up.	
2:55:08	32	323	45.93331	-129.98153	The last float is removed from the cable.	
2:55:57	24	268	45.93324	-129.98153	Whoops. Looks like more floats on the cable.	
3:00:28	5	298	45.93323	-129.98150	ROPOS is at the surface.	
3:03:36	3	353	45.93328	-129.98149	ROPOS is on deck. End of dive R1011.	
3:10:18	3	275	45.93328	-129.98149	The end of a great dive.	R1011-147

5.6.5 R1012 - ’98 Lava Flow East/West Traverses (Axial)

R1012 1998 lava flow - E/W traverses. [R1012 Bottom time: 9/2 1627 - 9/3 0029 (8 hrs 2 min)] Completed 4 geological transects (E/W or W/E) across the 1998 lava flow to characterize lava features and types, observing lava flow boundaries along the way. Started in the southwest on the older lava flow. Traveled east to the topographic high north of castle. Next traveled north then west across the '98 flow. Headed north then east again, over the Mkr-33 area. Discovered venting to the west of Mkr-33 with small tubeworms and chemosynthetic clams (ChemoClams target). Also discovered new venting on pillars east of Mkr-33. Traveled north along the east edge of the flow, then westward across the flow (N of Mkr-N41). Discovered another large area of diffuse venting in a collapse/lava pillar area and dubbed it Zen Garden. Sampled lava pillars along the transects. Recovered a wood experiment for Verena. Recovered the rumbleometer north of Mkr-33 - out here since 1998. 7 samples total. 4 pillars (many pieces), 2 sediment samples for volcaniclastic glass, 1 bio sample (chemosynthetic clams).

Time	Z	Hdg	raw lat	raw long	R1012 Comments: ’98 Lava Flow E/W Traverses (Axial)	FrGrab
15:13:43	2	340			ROPOS is in the water.	
15:13:48	2	318			ROPOS is in the water.	R1012-001
15:14:40	12	302	45.89772	-130.03098	DVD recording has started.	
15:33:53	218	353	45.92997	-129.98970	Descent is well underway.	
16:26:53	1524	96	45.93003	-129.98967	On the bottom - DVCAM video started.	
16:27:01	1523	95	45.93003	-129.98963	This is maybe some sort of salp.	R1012-002
16:27:52	1528	91	45.93005	-129.98940	ROPOS reached the bottom.	R1012-003
16:28:36	1527	89	45.93005	-129.98932	A very active rattail seen around here.	
16:29:11	1527	93	45.93006	-129.98928	Seastar on the seafloor.	R1012-004
16:29:43	1527	105	45.93009	-129.98915	At the first waypoint (WP1). We are in the **older lava west of the 1998 flow**. We are looking for a piece of lava pillar to sample from this region.	
16:35:59	1527	163	45.93012	-129.98853	We are going back to the line and then heading east.	
16:38:32	1525	92	45.93010	-129.98772	We have arrived at some lava pillows.	
16:41:41	1524	121	45.92995	-129.98725	We may be getting into some good pillar territory.	
16:41:46	1524	121	45.92994	-129.98726	Here is a fish on the seafloor.	R1012-005
16:43:32	1525	157	45.92991	-129.98729	Here is a drained out lobe.	R1012-006
16:44:16	1526	132	45.92989	-129.98730	Looking around the corner here for a nice pillar to sample.	
16:46:45	1524	127	45.92992	-129.98709	There was a small cul-de-sac here but there were no lava pillars inside. We are heading to another collapse to check.	
16:47:38	1522	146	45.92992	-129.98702	A few nice lava pillars here. We are going to try a thin one.	
16:49:30	1525	22	45.92984	-129.98696	Here is a lava pillar.	R1012-007
16:50:07	1525	22	45.92984	-129.98697	This one may be a little large to sample. It is very wide.	
16:51:58	1524	100	45.92986	-129.98688	Tracking east to look for another pillar.	
16:55:05	1522	71	45.92979	-129.98643	We may be in an area of the 1998 lava flow.	
16:56:51	1522	71	45.92984	-129.98598	We have given up on getting some old flow pillar on this side. Heading into the 1998 flows.	
17:00:38	1522	91	45.93009	-129.98534	Here is a spider crab on the seafloor.	R1012-008
17:02:11	1521	84	45.93012	-129.98495	A shallow collapsed pit. Some pillars likely near by.	
17:02:33	1520	84	45.93013	-129.98486	Here is lava pillar.	R1012-009
17:03:29	1519	99	45.93014	-129.98479	There are many collapsed pits in this area.	
17:04:26	1520	79	45.93014	-129.98457	Getting **close to the edge of the big collapse.**	
17:05:49	1520	111	45.93016	-129.98444	Lots of pillars in this region. We are going to try to sample one.	
17:08:09	1523	360	45.93015	-129.98435	Landing ROPOS to sample.	
17:08:47	1522	356	45.93015	-129.98434	Here are some lava pillars.	R1012-010
17:11:11	1523	333	45.93017	-129.98437	This is the first location for sampling lava pillars.	R1012-011
17:12:16	1523	334	45.93017	-129.98437	This is the first lava pillar sampled.	R1012-012
17:12:19	1523	334	45.93017	-129.98437	A piece of a pillar - the stump of one that had fallen over with a clear inner surface. Port-aft portion of the bio box. A second piece was added at 17:19. z=1522m. Near VSM2 site (West edge of 1998 flow); near WP2. **R1012-pillar-0001 (Chadwick)+F71**	
17:14:30	1523	335	45.93015	-129.98424	This is the second lava pillar sampled. Not sure if it's from the same pillar as our first grab or not. All are in a jumbled heap.	R1012-013
17:15:29	1523	335	45.93014	-129.98423	This is another view of the second lava pillar sampled.	R1012-014
17:18:39	1523	337	45.93014	-129.98427	Piece of pillar. Sample 1.	R1012-015
17:18:42	1523	337	45.93014	-129.98428	Piece of pillar. Sample 1.	R1012-016
17:18:48	1523	337	45.93014	-129.98428	Piece of pillar. Sample 1.	R1012-017
17:20:31	1523	337	45.93014	-129.98428	**Heading to waypoint 3. It is about 300m due east.**	
17:22:35	1521	91	45.93014	-129.98400	We are now getting into the **main part of the collapse**. There will be fewer pillars as we continue to the east.	
17:22:35	1521	91	45.93014	-129.98400	We're in the main part of the collapse.	R1012-018
17:23:37	1523	93	45.93015	-129.98366	We're in the middle of the flow now and will be at the other side soon. The pillars ran out quickly. They were near the edge of the collapse.	R1012-019

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
17:23:42	1523	93	45.93015	-129.98364	It did not take long for the pillars to run out. They were all right beside the edge of the collapse.	
17:24:25	1523	92	45.93014	-129.98336	These are ropey lavas.	R1012-020
17:25:56	1524	93	45.93013	-129.98290	Still heading east to WP3. Still in the collapse area.	R1012-021
17:25:56	1524	93	45.93013	-129.98290	Still heading east to waypoint 3. We are about in the middle of the collapsed area.	
17:26:48	1525	92	45.93014	-129.98270	It is almost all ropey lava on the floor of the collapse. The bottom level undulates up and down and is quite chaotic.	
17:26:55	1524	92	45.93014	-129.98266	In the video the bottom goes up and down but the depressions and ridges we see in the bathymetry are not distinct on the bottom.	R1012-022
17:28:10	1524	97	45.93016	-129.98236	We have **entered into a lineated section**. The lines curve in an S-shape.	
17:28:13	1524	97	45.93016	-129.98235	Curvilinear lavas here on this sheet flow.	R1012-023
17:28:41	1524	97	45.93015	-129.98223	We are coming up to a change in the slope.	
17:28:42	1523	97	45.93015	-129.98222	The edge of a channel? Drop off or just slope change.	R1012-024
17:29:07	1524	97	45.93015	-129.98212	There is a down drop here.	
17:29:10	1524	97	45.93015	-129.98211	Crossing a down drop here.	R1012-025
17:29:45	1525	102	45.93014	-129.98196	We're getting out of the lineated flow.	R1012-026
17:29:53	1525	103	45.93014	-129.98193	**Getting close to the eastern edge**.	
17:30:09	1522	87	45.93012	-129.98189	**Pillars have been spotted**. We are now looking for a good place to sample.	
17:30:20	1522	125	45.93014	-129.98187	We're back in the pillars again at the eastern edge of the survey.	R1012-027
17:31:26	1522	88	45.93008	-129.98183	Lava pillars on this eastern edge of the collapse.	R1012-028
17:31:54	1522	91	45.93008	-129.98183	Wild looking pillars.	R1012-029
17:32:44	1522	100	45.93010	-129.98183	Highlight on the DVCAM are running.	
17:33:04	1522	107	45.93011	-129.98182	Took several shots of this fat odd-looking pillar.	R1012-030
17:34:17	1518	174	45.93015	-129.98175	Still looking for a good pillar to sample.	
17:34:31	1518	224	45.93013	-129.98169	Looking for a piece of pillar to sample.	R1012-031
17:35:31	1518	312	45.93010	-129.98173	Lobate lavas on top of this pillar arch.	R1012-032
17:36:44	1522	277	45.93012	-129.98173	Looking at this fallen pillar to sample a part of it.	R1012-033
17:38:13	1523	277	45.93010	-129.98173	Sample 2. A piece of this small fallen pillar. Notice the glass in the center.	R1012-034
17:38:24	1523	276	45.93010	-129.98173	A piece of a pillar - as with the first sample this is a fallen over stump. Port-Forward section of the bio box. A second piece added at 17:41. A third at 17:42. z=1522m. Near Waypoint 3; Eastern edge of the 1998 lava collapse. **R1012-pillar-0002 (Chadwick)+F101**	
17:41:19	1523	277	45.93010	-129.98174	Another piece (sample 2) from the 1998 lava flow - eastern edge.	R1012-035
17:42:46	1523	275	45.93010	-129.98174	One more piece for sample2. 1998 flow - piece of this fallen lava pillar. 3 pieces total for sample 2. Port forward bio box.	R1012-036
17:44:35	1523	277	45.93010	-129.98174	A large lava pillar with very deep bathtub rings.	
17:44:42	1523	277	45.93010	-129.98174	On the eastern edge of the flow. Lava ledges on these pillars are spectacular.	R1012-037
17:44:57	1523	277	45.93010	-129.98174	Heading further east to do a suction for glass pieces.	
17:45:27	1522	283	45.93009	-129.98174	Took some DSCs of these pillars too.	R1012-038
17:46:19	1519	96	45.93009	-129.98180	We are about to enter the lobate surface. As we head east we quickly leave the collapse.	
17:46:27	1519	97	45.93009	-129.98178	Eastern edge of the collapse. This is right beyond the roof.	R1012-039
17:47:02	1520	98	45.93009	-129.98163	Contact of lobate flow (top of flow) and pillows. These pillows are older. They are not the 1998 flow.	R1012-040
17:47:10	1519	98	45.93010	-129.98161	We have entered the old pre-1998 flows.	
17:48:11	1521	101	45.93012	-129.98156	We're in older lavas now. Definitely more sediment here. Will suction for volcaniclastic glass in these seds for Dave Clague.	R1012-041
17:48:34	1521	102	45.93011	-129.98153	Getting the suction ready.	
17:49:40	1521	102	45.93012	-129.98151	Will suction in this area.	R1012-042
17:49:49	1521	102	45.93012	-129.98151	We're going to sample the sediments here.	R1012-043
17:50:33	1521	102	45.93012	-129.98151	Sampling sediment for the volcanic glass. Into Jar #5 with am mesh size. z=1520m. WP3 (eastern edge of 98 lava collapse in pillar area). **R1012-SS-0003 (Clague)+F119**	
17:50:36	1521	102	45.93012	-129.98151	Suction sample (sample #3) on the older flow - east of the 1998 flow. Area of pillows.	R1012-044
17:51:34	1521	102	45.93012	-129.98151	Suction sample (#3).	R1012-045
17:53:00	1521	102	45.93012	-129.98151	The suction sample on this older flow east of the 1998 flow.	R1012-046
17:56:00	1521	102	45.93013	-129.98153	We are sampling sediments on the seafloor.	R1012-047
18:00:04	1521	101	45.93013	-129.98153	Flushing the hose into the flush jar.	
18:01:07	1521	101	45.93014	-129.98152	Heading to waypoint 4.	
18:03:44	1518	55	45.93018	-129.98140	Heading NE over this older hill of pillow lavas.	
18:04:56	1513	27	45.93046	-129.98100	Heading around the edge of a large fissure.	

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
18:06:24	1510	39	45.93086	-129.98071	Another **big fissure here**. The altitude jumped to 12m so it was about 10m deep.	
18:09:00	1522	42	45.93143	-129.97985	We are on our way to WP4.	R1012-048
18:12:33	1522	48	45.93202	-129.97923	Approaching the waypoint. This is older lavas east of the 1998 flows. There maybe be some pillars here.	
18:13:19	1522	49	45.93212	-129.97916	A medium sized collapsed area here. There are some pillars.	
18:13:50	1523	71	45.93215	-129.97907	Here is a lava pillar at **WP4**.	R1012-049
18:15:13	1523	207	45.93218	-129.97900	This looks like a good place to sample. We have to wait for the ship to catch up.	
18:16:18	1525	196	45.93219	-129.97900	On the bottom in a collapsed pit.	
18:16:27	1525	193	45.93219	-129.97900	Here is a lava pillar.	R1012-050
18:17:51	1525	192	45.93218	-129.97900	Checking out this pillar here to see if it is hollow.	
18:19:34	1525	190	45.93218	-129.97900	The hole on that piece of pillar looked a little strange so it was not sampled. Moving a little to try another piece.	
18:22:10	1525	206	45.93218	-129.97899	Here we can see some volcanic glass (in black).	R1012-051
18:24:09	1519	72	45.93218	-129.97902	Heading west to look for another pit.	
18:26:37	1520	274	45.93218	-129.98001	This could be the 1998 lava. There was no distinct edge but it looks darker and has less sediment on it.	
18:27:52	1521	276	45.93217	-129.98072	We haven given up on getting an older pillar on the east side of the collapse.	
18:28:49	1520	202	45.93220	-129.98102	We are going to turn left to an older pillow hill in the middle of the 1998 flows. We will be doing a suction sample for volcanic glass.	
18:29:39	1519	195	45.93211	-129.98107	We are **in the older pillows**.	
18:30:23	1518	189	45.93205	-129.98108	Positioning to suction sample here.	
18:30:42	1517	185	45.93205	-129.98109	We are about 115m SE of Marker 33.	
18:30:53	1518	183	45.93205	-129.98109	We are going to do a suction sample at this location.	R1012-052
18:33:56	1519	169	45.93205	-129.98109	Suction sediment for volcanic glass into Jar #6. It has 1mm mesh. z=1518m. 115m SE of Marker 33 in older pillows. **R1012-SS-0004 (Clague)**	
18:34:18	1519	169	45.93205	-129.98109	We are sampling volcanic glass particles.	R1012-053
18:47:30	1519	169	45.93205	-129.98109	Done with the suction sample. We are currently about 150m west of waypoint 4.	
18:49:10	1515	279	45.93205	-129.98109	Heading along the track line to the west looking for lava pillars.	
18:49:58	1519	288	45.93211	-129.98130	A collapse feature between wp 4 and 5.	R1012-054
18:51:09	1523	10	45.93209	-129.98142	We're **close to the eastern edge of the 1998 flow**. We're in the collapse area. Lots of broken pillars. This pillar has a red color to its base and almost a look of tree rings.	
18:51:23	1523	5	45.93209	-129.98142	A fallen lava pillar will make for a good sample. Too large to sample the whole thing...	R1012-055
18:51:49	1523	1	45.93209	-129.98142	The inside conduit of the pillar.	R1012-056
18:53:45	1523	2	45.93209	-129.98142	Somewhere near WP4 on the eastern edge of the collapse. Will continue west to WP5 after this.	
18:55:25	1523	7	45.93209	-129.98142	Trying to break this pillar up but it's tough.	
18:57:06	1523	4	45.93212	-129.98140	We tried to sample this fallen pillar.	R1012-057
18:58:10	1523	4	45.93212	-129.98140	We're picking up a piece of this to see if it's suitable. Not part of a pillar. Bill doesn't want it.	
18:58:15	1523	4	45.93212	-129.98140	Decided to sample this piece instead.	R1012-058
18:59:04	1523	4	45.93212	-129.98140	That piece was not part of a pillar though - so we dropped it.	R1012-059
19:00:35	1523	352	45.93212	-129.98139	Looking for another internal piece.	R1012-060
19:01:06	1523	352	45.93212	-129.98139	There's a small circular piece at the base of this fallen pillar that looks perfect.	
19:01:06	1523	352	45.93212	-129.98139	Found a small pillar that may be the perfect size sample.	R1012-061
19:03:19	1523	352	45.93212	-129.98139	Sampling the small piece of fallen pillar.	R1012-062
19:03:20	1523	352	45.93212	-129.98139	Picked up an end piece of this pillar. Quite a large piece. Placing in the stbd aft biobox. z=1523. E side of 1998 flow in collapse area. W of WP4. **R1012-pillar-0005 (Chadwick)**	
19:03:34	1523	352	45.93212	-129.98139	The pillar sample (#5).	R1012-063
19:04:22	1523	350	45.93212	-129.98139	Putting the sample (#5) in the biobox.	R1012-064
19:05:27	1523	350	45.93212	-129.98139	Sample #5 in the stbd-aft section of the biobox.	R1012-065
19:05:52	1523	350	45.93212	-129.98139	Took a digital and some frame grabs of the sample. The biobox cover doesn't seem to want to close tightly.	
19:09:15	1523	350	45.93211	-129.98139	Going to **continue west** after this.	
19:09:25	1523	350	45.93211	-129.98139	Standing pillars over 6 feet tall. We sampled a fallen one at the base of these (sample 5).	R1012-066
19:09:38	1523	350	45.93211	-129.98139	Standing pillars at the site we just sampled.	R1012-067
19:10:03	1523	350	45.93211	-129.98139	The pillars are over 6 feet high.	

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19:10:37	1523	350	45.93211	-129.98139	Standing pillars over 6 feet tall. We sampled a fallen one at the base of these (sample 5).	R1012-068
19:11:01	1522	357	45.93210	-129.98141	Taking some DSCs of these large pillars.	
19:11:37	1521	354	45.93212	-129.98139	The top of one of these beautiful tall pillars.	R1012-069
19:12:25	1521	356	45.93213	-129.98139	We're on our way west now (really). We're in the 98 collapse. A bit SE of Mkr-33. The collapse is relatively narrow here so have lots of pillars.	
19:13:45	1521	275	45.93215	-129.98150	Driving west from sampling site.	R1012-070
19:14:04	1521	273	45.93215	-129.98154	Small collapse feature.	R1012-071
19:14:27	1523	273	45.93216	-129.98159	We've left the pillars behind and we're in ropey to jumbled flow.	
19:14:54	1525	273	45.93217	-129.98166	Ropey jumbled flow in the collapse.	R1012-072
19:15:19	1524	273	45.93217	-129.98169	Ropey jumbled flow in this collapse.	R1012-073
19:15:28	1524	274	45.93217	-129.98171	Here's a pillar "wall" with a crab on the top of it. These arches are really fat.	
19:15:33	1523	273	45.93217	-129.98172	Large pillars.	R1012-074
19:16:14	1520	267	45.93217	-129.98176	Huge pillars and arch with crab on top.	R1012-075
19:16:30	1520	265	45.93217	-129.98176	Lava arches.	R1012-076
19:16:39	1520	265	45.93218	-129.98176	Huge pillars and arch with crab on top.	R1012-077
19:17:11	1518	266	45.93217	-129.98178	Back set of pillars as we are leaving.	R1012-078
19:17:23	1519	263	45.93217	-129.98180	Turned on the highlights. We're right back into the pillars. Big arches and solitary pillars.	
19:17:51	1520	267	45.93216	-129.98184	More isolated pillars.	R1012-079
19:18:37	1520	270	45.93214	-129.98198	More large fat pillars with roofs.	R1012-080
19:19:26	1520	264	45.93214	-129.98210	A solitary pillar in the midst of this collapse.	R1012-081
19:19:45	1519	264	45.93214	-129.98214	Lava pillars and arch.	R1012-082
19:19:52	1519	267	45.93214	-129.98216	Reached the **edge of the collapse**.	R1012-083
19:19:55	1519	263	45.93214	-129.98216	We're coming to the edge where there is some intact roof.	
19:20:04	1519	265	45.93214	-129.98218		R1012-084
19:20:05	1519	265	45.93214	-129.98218	Edge where there is some intact roof.	R1012-085
19:20:25	1519	266	45.93214	-129.98223	Lobate lava roof and collapse pit.	R1012-086
19:20:35	1519	264	45.93213	-129.98226	Lobate roof.	R1012-087
19:20:51	1519	266	45.93213	-129.98230	We're over a **lobate surface with lots of collapse pits**. We can see that there are large cavities inside with some pillars holding up the roof.	
19:20:55	1519	265	45.93213	-129.98231	Small collapse pits in the lobate surface.	R1012-088
19:21:13	1519	268	45.93211	-129.98235	Collapse pit. We can see that there are large cavities inside with some pillars holding up the roof.	R1012-089
19:21:29	1518	264	45.93211	-129.98239	Moving the DSCs now.	
19:21:36	1519	264	45.93211	-129.98241	The edge of a larger collapse feature.	R1012-090
19:21:45	1519	265	45.93211	-129.98245	Large roof on pillars between two collapse pits.	R1012-091
19:21:50	1519	265	45.93209	-129.98247		R1012-092
19:21:56	1520	265	45.93210	-129.98250	Lobate on top of pillars.	R1012-093
19:22:21	1519	267	45.93211	-129.98261	Lava archway on the west side of the collapse	R1012-094
19:22:53	1519	260	45.93211	-129.98271	We're at this lava archway on the west side of the collapse. We have ~100 more meters of this collapse area and then the bottom will be more intact.	
19:22:54	1519	260	45.93211	-129.98271	Another arch marking the edge of a collapse feature.	R1012-095
19:23:49	1520	268	45.93212	-129.98291	Wall perhaps formed between pillars.	R1012-096
19:23:56	1520	269	45.93212	-129.98293	These walls seem to form between these pillars.	
19:24:20	1520	268	45.93212	-129.98298	Rubble inside of a collapse basin.	R1012-097
19:24:38	1520	268	45.93211	-129.98303		R1012-098
19:24:43	1520	269	45.93211	-129.98304	The edge of the basin.	R1012-099
19:24:54	1521	264	45.93211	-129.98307	Big pillar here.	R1012-100
19:25:04	1521	266	45.93212	-129.98309	About half collapse half un-collapse here.	
19:25:05	1521	265	45.93212	-129.98309	The lobate roof.	R1012-101
19:25:30	1520	258	45.93211	-129.98314	Looking down into a collapse feature.	R1012-102
19:25:44	1520	264	45.93211	-129.98316		R1012-103
19:26:00	1520	263	45.93211	-129.98318	Very bizarre feature here. Looks like a lava lobe that has a hollow opening at one end lying on top of this pillar complex.	
19:26:09	1520	265	45.93211	-129.98318	Hollow lava lobe lying on top of this pillar complex.	R1012-104
19:26:48	1520	266	45.93211	-129.98327		R1012-105
19:26:56	1520	265	45.93211	-129.98329	The edge of the collapse.	R1012-106
19:27:16	1519	264	45.93212	-129.98335	Back into the sedimented lobate flow.	R1012-107
19:27:23	1519	266	45.93212	-129.98338	Turned the highlights off after 10 minutes.	
19:27:39	1519	264	45.93212	-129.98343	**We're out of the collapse**. There are a few small pits but less of them. Mostly lobate flow here.	
19:27:48	1519	265	45.93212	-129.98347	Out of the large collapse - still noticing a few pits.	R1012-108
19:28:25	1519	265	45.93212	-129.98363	Nice pillars and roof.	R1012-109
19:28:57	1519	266	45.93211	-129.98375	We're approaching the western edge of the flow. Probably thinner with less drain-out here.	

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19:29:40	1518	266	45.93209	-129.98390	Looks like a railroad wheel. Says 98 on it. It's quite huge. Must have been a mooring.... Got a position: "Ghost train wheel".	
19:29:48	1519	267	45.93209	-129.98394	Got a position: "Ghost train wheel".	R1012-110
19:30:05	1520	268	45.93209	-129.98399	Unidentified "98" anchor.	R1012-111
19:32:01	1520	272	45.93205	-129.98441	Lava flow with sediment.	R1012-112
19:32:01	1520	272	45.93205	-129.98441	Not sure if we are on the 1998 flow anymore. It has a lot of sediment on it. This looks older. Lots of sediment in between the lobes.	
19:32:40	1520	272	45.93208	-129.98456	This is older flow than the 1998 flow.	R1012-113
19:33:13	1520	272	45.93210	-129.98470	We're looking at some collapse pits in this older flow. There are a few sessile creatures on this.	
19:33:18	1520	272	45.93210	-129.98472	Small collapse in older flow.	R1012-114
19:33:40	1521	265	45.93212	-129.98478	Larger collapse.	R1012-115
19:34:11	1520	273	45.93214	-129.98489	We're probably on an older flow than the 1998 flow. More sediment and animals here.	R1012-116
19:34:17	1520	273	45.93214	-129.98491		R1012-117
19:34:23	1521	274	45.93214	-129.98494	The edge of a larger collapse feature.	R1012-118
19:34:24	1520	274	45.93214	-129.98494	Looks like sea cucumbers and sea stars out here. We want to find a place where we can sample a pillar here.	
19:34:55	1520	270	45.93216	-129.98501	Collapse rim.	R1012-119
19:35:29	1520	276	45.93211	-129.98503	Roof on the edge of this collapse area.	R1012-120
19:35:57	1520	269	45.93209	-129.98507	Monstrous pillows here and still intact.	
19:35:59	1520	269	45.93210	-129.98508	Looking into a collapse feature. Big intact pillows at the bottom of this collapse.	R1012-121
19:36:28	1520	260	45.93213	-129.98514	Big intact pillows at the bottom of this collapse.	R1012-122
19:36:32	1520	250	45.93213	-129.98514	Nice roofs and collapse area here.	
19:37:17	1521	115	45.93211	-129.98520	A close-up inside the collapse feature.	R1012-123
19:37:38	1523	106	45.93210	-129.98518	Knocking over a pillar to sample it. It crumbled. We ended up taking a piece of this for sample 6.	R1012-124
19:39:28	1522	130	45.93211	-129.98517	Going to try to sample this older pillar. It is crumbling as it falls over.	
19:39:35	1523	141	45.93211	-129.98516		R1012-125
19:39:46	1523	128	45.93211	-129.98516	Unable to sample it so far.	R1012-126
19:42:21	1522	123	45.93210	-129.98517	Lining up to get a sample.	R1012-127
19:42:34	1522	123	45.93210	-129.98517	Still deciding what to sample.	
19:43:34	1523	139	45.93211	-129.98517		R1012-128
19:44:43	1523	118	45.93209	-129.98517	Still deciding what "older" lava pillar to sample.	
19:44:49	1523	119	45.93208	-129.98517	Fallen pillar.	R1012-129
19:45:24	1524	140	45.93209	-129.98516	2 pieces of this pillar stump were sampled (sample 6).	R1012-130
19:46:02	1524	164	45.93209	-129.98515	Sampling	R1012-131
19:46:12	1524	170	45.93210	-129.98515	Grabbed a rind of this pillar stump - sample 6.	R1012-132
19:46:14	1524	171	45.93210	-129.98515	Piece of rind from this older lava pillar (pre-1998 flow). We knocked this pillar over. Grabbed a couple pieces of the pillar stump. Right forward biobox. z=1524m. Close to WP 5 (east of it). **R1012-pillar-0006 (Chadwick)+F312**	
19:46:23	1524	176	45.93210	-129.98515	The first piece of sample 6.	R1012-133
19:46:53	1524	182	45.93210	-129.98514	Sample 6 in the right-forward biobox.	R1012-134
19:50:39	1524	176	45.93209	-129.98515	Sampling a piece of the pillar stump.	R1012-135
19:50:55	1524	176	45.93209	-129.98515	Putting the second piece of sample 6 in the stb-forward section of the biobox.	R1012-136
19:52:19	1520	286	45.93207	-129.98524	We're going to head northwest to WP6 from here.	
19:52:36	1520	313	45.93210	-129.98532	We are heading straight for wp 6 now; instead of going to wp 5 first.	R1012-137
19:52:56	1520	322	45.93215	-129.98538	There are some pretty intact pillows on this jumbled flow.	
19:53:39	1521	319	45.93225	-129.98552	Small collapse feature.	R1012-138
19:54:10	1518	305	45.93231	-129.98561	Left the collapse pit and are back into lobate flows.	
19:54:26	1519	304	45.93235	-129.98570	Lobate flows.	R1012-139
19:55:18	1521	302	45.93245	-129.98595	Remnants of older flow surrounded by younger flows.	R1012-140
19:55:20	1521	303	45.93245	-129.98596	Looks like **remnants of older flows surrounded by younger lavas**. Could be 1998 lava invading an older area.	
19:56:43	1521	302	45.93255	-129.98629	Lava pillars again.	
19:56:47	1521	298	45.93256	-129.98629	Pillars (old) with younger flows filling in the bottom.	R1012-141
19:56:52	1520	300	45.93256	-129.98629	The pillars are probably old. Looks like some younger flows (pillows and lobes) have filled in the collapse here. Not sure what's on the bottom here....	
19:57:17	1521	302	45.93259	-129.98633	Big lava pillar.	R1012-142
19:57:39	1521	300	45.93263	-129.98639	Top of this large pillar - looks like a lava lobe.	R1012-143
19:57:43	1521	300	45.93264	-129.98641	Close up view of the top of this pillar.	R1012-144
19:58:38	1522	303	45.93273	-129.98666		R1012-145

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
19:58:45	1521	302	45.93274	-129.98669	Looks like older lava here. Quite a bit of sediment cover... Also possibly some invading 1998 lava here and there. Looks like a mix of ages (some is more sedimented than others).	
19:58:47	1521	303	45.93274	-129.98670	Coming out of a little collapse pit.	R1012-146
19:59:08	1522	303	45.93279	-129.98680	Lobate flows both new and old.	R1012-147
19:59:44	1521	303	45.93286	-129.98699	Can see some almost shiny lobes here among the more heavily sedimented flows. Makes it complicated to map.	
19:59:47	1521	306	45.93286	-129.98700	Edge of an older collapse feature.	R1012-148
20:00:35	1521	300	45.93290	-129.98721	We're **going to go straight north from here and then head east (cutting off WP6).**	
20:00:46	1522	304	45.93291	-129.98726	Collapse feature.	R1012-149
20:01:18	1520	330	45.93295	-129.98735	Deciding to turn north here and cut the corner of the track lines before getting to wp 6.	R1012-150
20:02:16	1522	356	45.93305	-129.98747	An old collapse.	R1012-151
20:02:39	1522	357	45.93312	-129.98746	Larger collapse.	R1012-152
20:02:41	1522	356	45.93314	-129.98746	We were heading NW toward WP 6 and instead will cut the corner off. **Heading straight N and then will go E. We're in older lavas here - with collapse pits.**	
20:03:00	1521	357	45.93320	-129.98746	Older lobate flows.	R1012-153
20:03:25	1521	357	45.93327	-129.98746	Small collapse feature.	R1012-154
20:04:14	1520	358	45.93340	-129.98749	Edge of a large collapse pit.	R1012-155
20:04:31	1520	356	45.93345	-129.98748	There's a bunch of pillow lava in the bottom of this collapse pit.	
20:04:36	1521	357	45.93348	-129.98748	Lava flow in the bottom of the pit.	R1012-156
20:04:51	1523	340	45.93351	-129.98748	There is an old pillar complex surrounded by these pillows that have come into this collapse area.	
20:04:52	1523	340	45.93351	-129.98748	Old pillars surrounded by pillow basalts.	R1012-157
20:05:14	1523	331	45.93350	-129.98749		R1012-158
20:07:23	1521	220	45.93350	-129.98750	We've turned to the east now.	
20:07:40	1522	226	45.93346	-129.98753	We're heading toward WP7.	
20:08:23	1519	149	45.93333	-129.98749	We're driving SE now. Once the ship gets ahead of us we will drive in a more easterly line.	
20:08:34	1520	142	45.93329	-129.98746	Small collapse pit.	R1012-159
20:08:55	1521	140	45.93320	-129.98737	Edge of deep collapse.	R1012-160
20:08:58	1521	129	45.93318	-129.98735	We're flying over a deep collapse pit.	
20:09:20	1521	133	45.93312	-129.98726	Large collapse area.	R1012-161
20:09:48	1520	106	45.93305	-129.98708	We're out of the collapse pit.	
20:11:07	1519	118	45.93296	-129.98667	Bad visibility. Obviously an older flow here. Lots of biota on the lava.	
20:11:44	1520	74	45.93297	-129.98631	Contact between old and new flow.	R1012-162
20:11:45	1520	73	45.93297	-129.98630	Contact here from old flow to 98 flow.	
20:12:08	1519	74	45.93302	-129.98604	It looks a bit mixed up in here. We're going in and out of the new lava ('98) - which flowed into the collapse areas.	
20:13:02	1518	44	45.93317	-129.98554	Small collapse pit.	R1012-163
20:13:29	1518	12	45.93328	-129.98542	Small (but deep) collapse pit.	R1012-164
20:13:33	1518	19	45.93329	-129.98542	Big deep collapse pits here and there.	
20:13:55	1518	55	45.93336	-129.98539	We're pretty much b**ack on the line between WP6 and WP7. Turning due east on the line.**	
20:14:24	1519	88	45.93338	-129.98533	We wi**ll head toward Mkr-33 area.**	
20:15:32	1518	88	45.93338	-129.98494	Lobate flows with collapse features.	R1012-165
20:15:35	1519	87	45.93338	-129.98492	We're in lobate flows. Little collapse pits here and there. Quite a few animals on this flow. It should be new here.	
20:16:18	1519	87	45.93341	-129.98469		R1012-166
20:16:27	1518	84	45.93341	-129.98463	This looks pretty young right here. The lava lobes look quite shiny - even though there is quite a lot of sediment and some animals here.	
20:16:42	1518	84	45.93342	-129.98452		R1012-167
20:17:23	1519	91	45.93343	-129.98427	Coming up to the edge of the collapse area here. We will want a pillar sample here after looking around a bit.	
20:17:30	1519	91	45.93344	-129.98424	Edge of a collapse area.	R1012-168
20:17:59	1518	66	45.93343	-129.98419	Looking down in.	R1012-169
20:18:24	1519	111	45.93345	-129.98417	Many skinny pillars.	R1012-170
20:18:27	1519	110	45.93345	-129.98417	The bathymetry collected by the AUV totally shows this collapse.	
20:18:41	1519	102	45.93344	-129.98411		R1012-171
20:19:10	1518	29	45.93338	-129.98409	Lava pillars in the collapse area.	R1012-172
20:19:39	1519	101	45.93340	-129.98401	Inside the collapse.	R1012-173
20:20:06	1520	107	45.93340	-129.98395	Lava arch and deep bathtub rings.	R1012-174
20:20:10	1520	136	45.93340	-129.98394	Big pillars at the edge of the collapse.	R1012-175
20:20:13	1520	146	45.93340	-129.98394	Turning the highlights back on. Right on the edge of the collapse. Lots of pillars here.	

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20:20:58	1520	106	45.93340	-129.98380	Complex of large lava pillars.	R1012-176
20:21:21	1520	101	45.93339	-129.98377	A group of pillars very close together. Just beautiful.	R1012-177
20:21:22	1520	99	45.93339	-129.98377	A group of pillars very close together. Just beautiful.	
20:21:38	1520	105	45.93340	-129.98374	Close up of this group of pillars very close together.	R1012-178
20:21:54	1520	93	45.93339	-129.98370	Top of one of these pillars.	R1012-179
20:22:31	1520	86	45.93340	-129.98349	Now all of a sudden we're out of the pillars here. We went straight into lineated sheet flow after passing through this alcove full of pillars. We turned around to look at the pillars again and take more digitals.	
20:22:37	1520	76	45.93341	-129.98348	Suddenly out of the basin.	R1012-180
20:23:11	1521	249	45.93346	-129.98345		R1012-181
20:23:30	1520	229	45.93345	-129.98353	Back in pillars. Looks like the walls of these pillars are sandwiched together.	R1012-182
20:23:41	1520	228	45.93345	-129.98353	Looks like the walls of these pillars are sandwiched together.	
20:23:41	1520	228	45.93345	-129.98353	Small lava drips visible here.	R1012-183
20:24:09	1521	195	45.93347	-129.98358		R1012-184
20:24:29	1522	208	45.93347	-129.98356	The walls are almost honeycombed and sandwiched together - small lava drips.	
20:24:33	1522	202	45.93347	-129.98357		R1012-185
20:24:48	1522	208	45.93346	-129.98357	Can see lava drips off the rind of this pillar.	R1012-186
20:24:56	1522	212	45.93346	-129.98357	Close up of lava drips.	R1012-187
20:25:00	1522	228	45.93345	-129.98355	Complex lava pillar with drips.	R1012-188
20:25:01	1522	227	45.93345	-129.98355	Lava drips.	R1012-189
20:25:17	1522	238	45.93344	-129.98355	Cool lava drips in this pillar.	
20:25:30	1522	242	45.93344	-129.98355	Looking at this complicating lava pillar **- lava drips present.**	R1012-190
20:25:53	1520	79	45.93344	-129.98360	We're turning east again and are suddenly and abruptly in **flat lineated flow.**	
20:26:01	1520	71	45.93345	-129.98355	Flat lineated sheet flow just outside of the collapse basin.	R1012-191
20:26:49	1522	62	45.93345	-129.98337	Very abrupt. All of a sudden no pillars.	
20:27:10	1523	68	45.93344	-129.98333	Turning the highlights off.	
20:27:52	1523	86	45.93349	-129.98310	We know we're on the 98 flow and are curious as to what the little white things are. Looks like sponges - but could be anything.	
20:28:11	1524	83	45.93349	-129.98308	Sheet flow biota.	R1012-192
20:28:25	1524	84	45.93349	-129.98307	Zooming in on this biota and iron sediments.	R1012-193
20:28:33	1524	84	45.93348	-129.98307		R1012-194
20:28:38	1524	84	45.93348	-129.98307	Tubeworms here too.	R1012-195
20:29:13	1524	84	45.93348	-129.98307	Bill doesn't think they're sponges but we don't know what they are. They're shells. Where did they come from? That's odd. They're all over the place out here. There are some small tubeworms in the cracks too.	
20:29:34	1524	84	45.93348	-129.98307	Broken shells.	R1012-196
20:30:11	1524	84	45.93348	-129.98307	**Clams in long linear rows along cracks.** There are also tube worms in the area.	R1012-197
20:31:04	1524	94	45.93348	-129.98304	They're in long linear rows along cracks. There are also tube worms in the area. **They are clams and they are alive!!**	
20:31:15	1524	94	45.93348	-129.98304	**Bivalves with tubeworms.**	R1012-198
20:31:34	1524	94	45.93348	-129.98304	Something very cool (or is it warm) here. There probably is not that much flow here but enough flow to have tubeworms and these clams. Very interesting.	
20:31:35	1524	94	45.93348	-129.98304	Close up of clams and tubeworms.	R1012-199
20:33:04	1524	94	45.93348	-129.98304	We're going to take a suction into jar 1 (180 micron mesh). Want to try to get these clams.	
20:35:40	1524	94	45.93348	-129.98304	No noticeable shimmering. We'll take a closer look now.	
20:36:07	1524	94	45.93348	-129.98304	Very stunted small tubeworms in this area too. Looking for shimmer.	
20:36:26	1524	94	45.93348	-129.98304	Suction sampling.	R1012-200
20:36:28	1524	94	45.93348	-129.98304	Suction chemosynthetic clams into jars #1;2;7. Too large for the hose. Some iron-type seds and tiny tubeworms too. Put a few clams into port rear biobox. Will try to get a couple more in biobox. z=1524m. 68 m W of Mkr-33. (Chemo Clams target). **R1012-SS-0007 (Rose)**	
20:38:20	1524	94	45.93348	-129.98304	Suction area.	R1012-201
20:38:47	1524	94	45.93348	-129.98304	Suction jar 1 after first attempt at sampling.	R1012-202
20:41:55	1524	94	45.93348	-129.98304	Holding one in the suction sampler to drop in the biobox.	R1012-203
20:42:52	1524	94	45.93348	-129.98304	Sample in the port-rear biobox section.	R1012-204
20:50:27	1524	93	45.93348	-129.98305	The clams are getting stuck in the suction tube so will pick up a couple with the hose and try to put them in the biobox.	
20:51:10	1524	93	45.93348	-129.98305	Continuing sampling	R1012-205
20:52:11	1524	93	45.93348	-129.98305	The suction tube appears to be clogged. The clams are going in the port rear biobox. Got quite a few.	
20:52:20	1524	93	45.93348	-129.98305	Another one goes into the port-rear biobox.	R1012-206
21:00:37	1524	93	45.93348	-129.98304	It doesn't want to go up the hose. They're too big.	

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
21:02:46	1524	93	45.93348	-129.98304	Going to try to switch to jar 7 now. We didn't get any clams in the suction jars but several in the biobox. The suction sampler is done for on this dive.	
21:06:11	1524	93	45.93348	-129.98305	Transferring the DSCs. Will move on to Mkr-33 next.	
21:07:21	1524	85	45.93347	-129.98297	Moving east towards Mkr 33.	R1012-207
21:07:24	1524	87	45.93348	-129.98296	We're **moving east towards Mkr-33.** Still seeing little clams and tubeworms living along these cracks in the flat lineated flow.	
21:08:27	1523	83	45.93348	-129.98271	We're going to look for a wood sample located 20 m north of Mkr-33.	
21:08:36	1523	86	45.93347	-129.98269	Patches of tubeworms and clams west of Mkr-33.	R1012-208
21:08:57	1523	86	45.93347	-129.98263	Biota (including mat) in these cracks.	R1012-209
21:09:00	1523	83	45.93346	-129.98263	There are lots of tubeworms ahead along these cracks. They are getting larger and healthier.	
21:09:28	1523	91	45.93346	-129.98253	Tubeworm bushes and clams here.	R1012-210
21:09:54	1523	89	45.93345	-129.98244	Lots of scattered tubeworm bushes here. Also patches of the clams.	
21:11:38	1522	359	45.93333	-129.98242	We're **north of Mkr-33 near the benchmark** looking for the small marker on the bag of wood. Want to collect Verena's wood here.	
21:13:05	1523	349	45.93353	-129.98245	Going a little farther. Looking for the mesh bag with wood.	
21:14:24	1523	269	45.93357	-129.98265	Marker and wood here. We found it. It was 40 m away from the benchmark.	
21:14:37	1523	288	45.93355	-129.98274	Lava swirl and Verena's wood.	R1012-211
21:17:18	1524	349	45.93354	-129.98285	Trying to figure out what to do with the marker attached to this bag of wood. It's pretty big.	
21:18:42	1524	349	45.93354	-129.98285	Debating on where to place the wood.	
21:20:45	1524	359	45.93354	-129.98285	Some shrimp were on the bag of wood - but they swam away.	
21:21:15	1524	359	45.93354	-129.98285	Securing the wood block.	R1012-212
21:21:25	1524	359	45.93354	-129.98285	Wood is going in the starboard front biobox. Its marker is going on top of the port side. It is not being marked as a sample.	
21:22:07	1524	359	45.93354	-129.98285		R1012-213
21:25:04	1524	359	45.93354	-129.98285	**RECOVERED the wood for Verena**. It's been out here since ~2003 or so. Not sure - could be 2004. The biobox is stuffed full.	
21:25:21	1524	359	45.93354	-129.98285	Securing the marker.	R1012-214
21:26:36	1524	359	45.93354	-129.98286	Doing a bit of housekeeping because we don't want that rope in the way of the video. There went the marker. More marker management.	
21:31:35	1524	359	45.93354	-129.98285	The darn thing don't want to stay in the box.	
21:37:12	1524	359	45.93354	-129.98285	Stowing this mesh bag of wood one more time.	
21:37:21	1524	359	45.93354	-129.98285	Securing the wooden block.	R1012-215
21:39:03	1524	359	45.93354	-129.98286	Let's go. **Heading east towards waypoint 7**.	
21:39:39	1523	91	45.93357	-129.98285	Headed east to wp 7.	R1012-216
21:40:02	1523	125	45.93358	-129.98276	Broken sheet flow.	R1012-217
21:40:56	1522	96	45.93356	-129.98251	**Pillar with tubeworms**. We didn't know this area of venting was here.	R1012-218
21:41:05	1522	79	45.93356	-129.98249	We're out of the sheet flow and into pillars. Here's a great pillar with tubeworms and blue mat on it.	
21:41:26	1522	39	45.93353	-129.98245	Pillars east of Mkr-33 with tubeworms on them.	R1012-219
21:41:40	1522	2	45.93352	-129.98241	**Pillar with tubeworms and blue mat!**	R1012-220
21:41:52	1522	42	45.93352	-129.98242	More pillars to the east. Several of them have tubeworms on them. Don't recall seeing this before.	
21:42:14	1521	97	45.93355	-129.98243	More pillars to the east.	R1012-221
21:42:30	1519	86	45.93355	-129.98239	Pillars with some hydrothermal biota. Very sparse but it's there.	R1012-222
21:42:53	1518	87	45.93357	-129.98234	Gauge check.	
21:43:36	1518	110	45.93359	-129.98222	Another collapse feature.	R1012-223
21:43:47	1518	109	45.93355	-129.98214	Out of lineated and right into pillars again. More and more intact roof here.	
21:44:46	1518	94	45.93353	-129.98186	Crossing a collapse pit. Small wall and another collapse.	
21:44:58	1522	97	45.93354	-129.98180	Inside a large collapse pit.	R1012-224
21:45:20	1522	96	45.93354	-129.98171	The edge of the pit.	R1012-225
21:45:35	1521	72	45.93353	-129.98168	Some large pillars on the edge of this deep collapse. Actually in between 2 collapse pits.	
21:45:44	1520	49	45.93353	-129.98169	Large pillar between 2 collapse areas.	R1012-226
21:47:18	1518	88	45.93359	-129.98167	Continuing east.	
21:47:46	1522	87	45.93361	-129.98153	Lots of collapse rubble here and more pillars - actually a wall here.	
21:47:46	1522	87	45.93361	-129.98153	Collapse rubble.	R1012-227
21:47:57	1523	89	45.93362	-129.98151	Wall of the pit.	R1012-228
21:48:18	1522	87	45.93361	-129.98148	Lava wall on the edge of this collapse pit.	R1012-229
21:48:53	1522	65	45.93362	-129.98147	Big beautiful pillars.	R1012-230
21:49:26	1522	46	45.93360	-129.98145	The lasers are 10 cm apart. Trying to get some scale here on these pillars. Several lobes piled on top of each other here.	
21:49:27	1522	46	45.93360	-129.98145	Several lobes piled on top of each other here.	R1012-231
21:50:01	1521	42	45.93360	-129.98144	Several lobes piled on top of each other here.	R1012-232

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
21:50:20	1521	49	45.93360	-129.98145	We are probably at the edge of the collapse. Are passing over the pillars now. Look at all the lava drips here.	
21:50:40	1521	108	45.93363	-129.98145	Lava lobes on top of large pillars.	R1012-233
21:50:52	1522	143	45.93364	-129.98144	Large lava pillars.	R1012-234
21:51:10	1523	132	45.93364	-129.98143	Large lava pillars standing and some broken pillars in the collapse area.	R1012-235
21:51:13	1523	130	45.93363	-129.98143	Large lava pillars standing and some broken pillars in the collapse area.	R1012-236
21:51:21	1523	117	45.93363	-129.98144	Large lava pillars standing and some broken pillars in the collapse area.	R1012-237
21:51:45	1523	110	45.93362	-129.98145		R1012-238
21:51:59	1523	105	45.93363	-129.98145	Weird ridges on the edge of this pillar. They are lava drips - just very different looking.	
21:52:00	1523	105	45.93363	-129.98145	Weird lava drips on the top of this pillar.	R1012-239
21:52:37	1523	107	45.93363	-129.98145	Weird lava drips on the top of this pillar.	R1012-240
21:52:41	1523	106	45.93363	-129.98145		R1012-241
21:53:21	1521	103	45.93363	-129.98147	Lava lobes piled on top of each other - lots of lava drips too.	R1012-242
21:54:06	1519	74	45.93362	-129.98137	Back in the lobate flow. Looks pretty solid so far.	
21:54:44	1520	100	45.93362	-129.98122	Lobates east of the collapse.	R1012-243
21:55:22	1520	94	45.93363	-129.98109	Collapse feature.	R1012-244
21:55:32	1520	92	45.93364	-129.98110	Another collapse pit here.	
21:56:11	1519	96	45.93366	-129.98095	Stopping the highlights after 10 minutes.	
21:56:22	1519	102	45.93366	-129.98089	Intact pillow basalts.	R1012-245
21:56:23	1519	101	45.93366	-129.98087	Lavas are pretty intact out here. Getting into more pillows and lobate flows. Getting thinner. Probably near the edge of the 1998 flow.	
21:57:12	1521	97	45.93364	-129.98056	Looks like old collapse remnants that the new lava has run up against. It's a jumbled sheet flow with a lot of relief.	
21:57:18	1522	97	45.93364	-129.98055	Old collapse remnants.	R1012-246
21:58:03	1521	97	45.93364	-129.98044	That was the boundary between the 1998 lava and the old lava to the east. The old flow looks like mostly jumbled lavas. The lava flow is deeper here.	
21:59:03	1520	93	45.93365	-129.98032	We're **cutting the corner here and will head north. Traveling to the general vicinity of WP8 over this old jumbled flow**. Looks more lobate here.	
22:00:38	1522	65	45.93368	-129.97999	We are turning now.	
22:01:55	1521	14	45.93392	-129.97981	Small collapse feature.	R1012-247
22:02:59	1522	357	45.93399	-129.97985	Older lobate flow east of the 1998 flow.	R1012-248
22:04:14	1520	2	45.93405	-129.97989	Lavas here are quite heavily sedimented. Lobates and scattered pillows.	
22:05:29	1520	1	45.93420	-129.97987	Edge of a larger collapse feature.	R1012-249
22:05:35	1520	359	45.93423	-129.97987	We're at a collapse pit in this older flow east of the 1998 lava.	
22:05:57	1520	359	45.93437	-129.97987	The upper crust is supported by little pillars that you can see under the flow surface - on the older flow.	
22:06:07	1520	359	45.93444	-129.97987	Small pit.	R1012-250
22:07:37	1521	358	45.93505	-129.97987	Older sedimented lobates.	R1012-251
22:07:42	1521	359	45.93508	-129.97986	Older lobates with an occasional collapse pit. Larger collapse ahead.	
22:07:59	1521	359	45.93516	-129.97984	Edge of a collapse.	R1012-252
22:08:32	1520	359	45.93528	-129.97979	Collapse on old flow.	R1012-253
22:08:44	1520	357	45.93535	-129.97980	Smaller collapse pit.	R1012-254
22:09:02	1521	356	45.93542	-129.97979	Area of many small collapse pits.	R1012-255
22:09:07	1521	356	45.93544	-129.97979	Just passed over an area with more collapse pits than before. In the bathymetry it looks like we are just west of an extensive collapse (to our east) on the older flow.	
22:10:56	1521	358	45.93607	-129.97993	Old sedimented flows.	R1012-256
22:12:23	1521	355	45.93638	-129.98005	We've been going over the older flow with not much collapse at all.	
22:15:12	1520	356	45.93676	-129.98009	Small collapse feature.	R1012-257
22:16:52	1519	356	45.93713	-129.98021	Still traveling over this older lobate flow with lots of sediment.	
22:17:17	1515	281	45.93715	-129.98023	We just passed WP8 and are turning to the west.	
22:17:43	1517	269	45.93711	-129.98036	Not much collapse here. We're 4 or 5 meters above the bottom.	
22:18:01	1519	273	45.93709	-129.98043	Lobate flows - not much collapse.	R1012-258
22:18:06	1520	275	45.93708	-129.98046	Looking better now.	
22:19:34	1518	286	45.93709	-129.98083	Looks like lots of sediment here - probably hydrothermal. Lots of yellowish deposits around the lobes here. Should be older lavas. Still on lobates but should be crossing a large collapse soon.	
22:19:37	1519	282	45.93709	-129.98084	Area with a lot of sediment - and some bacterial mat (once active).	R1012-259
22:20:29	1520	285	45.93706	-129.98097	Area with a lot of sediment - possibly hydrothermal sed.	R1012-260
22:20:43	1519	285	45.93704	-129.98099	We're on the edge of the collapse now. Just turned to the south. It's not super deep. Looks like its been filled in. Looking SW. Not a huge pit.	
22:20:44	1519	285	45.93703	-129.98099	Edge of the collapse.	R1012-261
22:21:01	1519	261	45.93700	-129.98097	Looking down in.	R1012-262
22:21:15	1520	237	45.93699	-129.98095		R1012-263
22:22:06	1521	310	45.93696	-129.98100	Inside the pit.	R1012-264

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
22:22:14	1521	314	45.93697	-129.98101	This is the solitary pillar that we want to sample. It was later knocked over.	R1012-265
22:22:19	1522	311	45.93697	-129.98101	Bill wants a piece of an older pillar here.	
22:22:38	1522	301	45.93699	-129.98102		R1012-266
22:23:48	1522	351	45.93699	-129.98105	We knocked the big old pillar over - going to try to get a piece of it.	
22:27:49	1518	227	45.93704	-129.98100	Waiting for the sediment to settle.	
22:30:41	1522	320	45.93697	-129.98102	Still pretty murky - but looking better. Looking around for the fallen pillar.	
22:31:05	1522	4	45.93698	-129.98105	When the sediment settled we found our fallen pillar.	R1012-267
22:31:13	1521	7	45.93698	-129.98106	Going to try to grab a piece of this old pillar.	
22:32:22	1522	26	45.93700	-129.98108	We want to break off a piece of the inner rind of this old pillar.	
22:32:25	1522	26	45.93699	-129.98108	The base of the broken pillar.	R1012-268
22:33:58	1522	31	45.93702	-129.98109	Think that they're picking up a piece of this pillar but the muck in the water is so thick we can't see. We're popping up and will continue going west.	
22:34:49	1519	316	45.93705	-129.98107	After giving up - we keep heading west.	R1012-269
22:35:04	1518	327	45.93711	-129.98115	We're heading west again. More tubeworm patches here again. The lava looks fairly young.	
22:35:32	1520	317	45.93721	-129.98122	Younger looking lava with tubeworm patches.	R1012-270
22:35:57	1519	297	45.93724	-129.98122	Lots of patches of little tubeworms; maybe some limpets; bacterial mat and some of those chemosynthetic clams here. There's some shimmer here.	
22:36:00	1519	296	45.93724	-129.98122	Close-up of a tubeworm patch.	R1012-271
22:36:41	1518	259	45.93728	-129.98126	Here we notice some diffuse flow.	R1012-272
22:36:58	1519	263	45.93728	-129.98127	We see **shimmering water here. We're putting a target here called "Zen garden"**. Lots of tubeworms; biota; here on this younger lobate flow.	
22:38:00	1519	266	45.93728	-129.98132	Lot's of tubeworm patches in what is now called the Zen garden.	R1012-273
22:39:02	1519	235	45.93729	-129.98146	Coming upon a collapse pit with smoky water at the bottom. Filamentous mat on the side of the collapse wall.	
22:39:05	1519	234	45.93729	-129.98147	Coming up to a collapse pit - there looks to be venting down inside.	R1012-274
22:39:52	1520	200	45.93727	-129.98150	Looking down into the pit.	R1012-275
22:41:08	1517	72	45.93721	-129.98162	**We're looking back at the shimmering water area. Looks like most of it is at the surface here in the area of Zen Garden.**	
22:41:31	1519	52	45.93721	-129.98156	Looking back from the other side of the pit.	R1012-276
22:42:01	1521	61	45.93722	-129.98156	Diffuse venting pocket in the side of the pit wall at Zen Garden.	R1012-277
22:42:14	1522	65	45.93722	-129.98156	There's some blue mat here too. Also some mat on the bottom of the pillars.	
22:42:22	1522	63	45.93722	-129.98156	Area of venting on the side of the pit.	R1012-278
22:42:34	1523	61	45.93717	-129.98147	Inside the pit.	R1012-279
22:42:41	1523	65	45.93717	-129.98147	Inside the pit - you can see tubeworm patches in the foreground.	R1012-280
22:42:53	1523	66	45.93717	-129.98147	Close-up of the bathtub rings on the side of the pit.	R1012-281
22:43:01	1523	58	45.93717	-129.98147	OK - we're heading west now. Switching out the video now.	
22:43:02	1523	60	45.93717	-129.98147	Close-up of the side of the pit.	R1012-282
22:44:02	1520	101	45.93719	-129.98149	Turning around and **heading west again**. We are somewhere east of the rumbleometer here.	
22:45:15	1521	264	45.93717	-129.98164	The sponges on the rocks mark older lava.	R1012-283
22:45:35	1522	267	45.93717	-129.98167	We have sponges on the lavas here and some sea stars. These are probably older lavas. Looks like some younger lavas mixed in.	
22:45:36	1522	267	45.93717	-129.98167	Close-up of sponges.	R1012-284
22:46:55	1522	266	45.93717	-129.98189	It's a bit confusing. The small batch of sponges could have been just a patch of older lava protruding through the younger stuff.	
22:47:35	1521	267	45.93717	-129.98200	Newer looking lava. The older lava may have been just a pocket surrounded by the 1998 flow.	R1012-285
22:47:56	1522	269	45.93717	-129.98218	Looks like this is the **eastern edge of the collapse here**. We're into collapse with pillars and jumbled lavas at the base.	
22:48:06	1522	271	45.93716	-129.98222	Edge of large collapse.	R1012-286
22:48:25	1522	270	45.93716	-129.98229	Collapse basin.	R1012-287
22:48:44	1523	273	45.93716	-129.98236	Pillars	R1012-288
22:49:06	1521	258	45.93716	-129.98245	Don't see any pillars ahead. We may be out of them already. That was quick. Looks like ropey to jumbled flow in the bottom here. The pillars were just on the margin. We're on the flats now.	
22:49:23	1522	256	45.93714	-129.98250	Floor of the basin is jumbled flow - out of the pillar zone.	R1012-289
22:49:59	1524	272	45.93711	-129.98264	Still in jumbled flow area.	R1012-290
22:50:50	1525	272	45.93711	-129.98295	More jumbled floor.	R1012-291
22:51:44	1525	271	45.93712	-129.98336	Entering area of linear sheet flow.	R1012-292
22:52:28	1525	272	45.93712	-129.98364	Ropey jumbled lava on the collapse area. Still heading west. Becoming a bit more jumbled.	
22:52:35	1525	272	45.93712	-129.98370	More jumbled floor.	R1012-293
22:52:54	1525	271	45.93712	-129.98383	Collapse wall.	R1012-294

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
22:52:55	1524	270	45.93712	-129.98384	Spotted some pillars.	
22:53:09	1524	271	45.93709	-129.98388	Collapse pillars.	R1012-295
22:53:38	1524	256	45.93709	-129.98386	Collapse pillars.	R1012-296
22:54:09	1524	215	45.93710	-129.98391	Collapse wall	R1012-297
22:54:19	1524	194	45.93710	-129.98393	Wall with crust on both sides.	
22:55:35	1522	269	45.93712	-129.98397	Lava pillars at the edge of a large collapse pit.	R1012-298
22:56:08	1521	281	45.93712	-129.98401		R1012-299
22:56:21	1522	284	45.93713	-129.98407	Bridge spanning the collapse.	
22:56:26	1522	281	45.93713	-129.98408		R1012-300
22:56:48	1522	262	45.93715	-129.98412	Pillars at the edge of a collapse. Weird lava "bridge".	R1012-301
22:57:02	1522	256	45.93717	-129.98413		R1012-302
22:57:12	1522	283	45.93716	-129.98414	This is the western edge of the collapse. The area is partly intact and partly collapsed.	
22:57:14	1522	288	45.93716	-129.98415	Western edge of the collapse. Partly intact; partly collapsed.	R1012-303
22:57:42	1522	291	45.93719	-129.98423	Area is becoming more intact as we head west.	
22:57:54	1521	271	45.93719	-129.98427	Edge of a small collapse pit.	R1012-304
22:58:10	1522	279	45.93718	-129.98431	Edge of a small collapse pit.	R1012-305
22:59:27	1522	271	45.93719	-129.98440	More intact lobates here as we continue west.	
22:59:30	1522	270	45.93719	-129.98441	Intact lobate flow.	R1012-306
23:00:33	1522	271	45.93718	-129.98464	Coming up to the edge of the long narrow collapse. It is deeper than many of the others.	
23:00:36	1522	270	45.93718	-129.98465	Edge of the long narrow collapse.	R1012-307
23:01:09	1521	272	45.93717	-129.98479	Stopping the traverse to look around here a little. Collapse runs mostly north-south.	
23:02:17	1522	349	45.93718	-129.98502	Collapse ends here. This is the north end.	
23:02:48	1519	316	45.93726	-129.98500	Weights potentially from a previous NeMO net buoy.	R1012-308
23:03:00	1518	307	45.93725	-129.98499	Stacks of railroad wheels.	
23:03:35	1518	170	45.93720	-129.98495	Headed back to the south and we are back to the collapse. Bottom is full of rubble with pillars on either side. Looks to be about 4 or 5 meters across.	
23:03:36	1518	170	45.93720	-129.98494	Pit to the south filled with rubble and has pillars on the side.	R1012-309
23:04:42	1519	181	45.93703	-129.98480	Narrow point in the collapse as we head south along it.	
23:04:42	1519	181	45.93703	-129.98480	Narrow part of collapse pit.	R1012-310
23:05:08	1521	189	45.93694	-129.98482	Unusually long and narrow pit.	R1012-311
23:05:26	1520	164	45.93686	-129.98484	We reached the **southern end of the long narrow collapse**. It is about 100 meters long.	
23:06:33	1522	298	45.93698	-129.98519	Continuing on our transect to the west.	
23:06:58	1522	282	45.93704	-129.98537	Edge of another unusual pit collapse - it is separated from the other pit.	R1012-312
23:07:00	1523	285	45.93704	-129.98537	Back at the edge of another large collapse. Ropey to jumbled flow down inside.	
23:07:26	1521	288	45.93708	-129.98543	Ropy and jumbled lava.	R1012-313
23:07:44	1524	287	45.93709	-129.98548	"Swiss cheese" effect of lava.	R1012-314
23:08:05	1524	284	45.93712	-129.98557	**Flows becoming less jumbled turning lineated as we continue west.**	
23:08:07	1524	284	45.93712	-129.98557	Flow is quite flat and ropy as opposed to earlier.	R1012-315
23:09:38	1525	270	45.93714	-129.98603	Middle of the collapse pit.	R1012-316
23:10:31	1525	269	45.93714	-129.98618	Here is a wall and more pillars.	
23:10:53	1524	257	45.93713	-129.98623	Lava pillar.	R1012-317
23:11:40	1521	262	45.93711	-129.98634	Additional lava pillars.	R1012-318
23:11:58	1521	321	45.93709	-129.98637	Lava pillars.	R1012-319
23:12:57	1520	234	45.93717	-129.98642	This looks like the edge of the collapse.	
23:12:59	1520	214	45.93717	-129.98643	Edge of the collapse.	R1012-320
23:13:18	1521	230	45.93711	-129.98647	"Garage"	R1012-321
23:13:39	1522	282	45.93710	-129.98646	Upper surface us usually about 10 cm thick.	
23:14:24	1525	253	45.93710	-129.98650	Drips on the underside of the flow ceiling.	R1012-322
23:14:35	1526	254	45.93710	-129.98649	There are large drips on the underside of the top crust. Stopping to have a look here.	
23:15:07	1526	255	45.93710	-129.98649	Jumbled ropey lava in a collapsed area.	R1012-323
23:16:57	1526	249	45.93711	-129.98650	There are what look like bits of pillars hanging from above.	
23:17:10	1526	250	45.93711	-129.98645	Bathtub rings on the side of the pit collapse.	R1012-324
23:18:36	1520	122	45.93706	-129.98638	Following the edge of the collapse along to the east.	
23:19:17	1520	116	45.93705	-129.98639	Edge of the collapsed pit.	R1012-325
23:19:49	1522	150	45.93708	-129.98630	Tracking along the edge of the collapse to the SE. There are little collapsed fragments away from the edge here. Flow becomes lineated away from the wall.	
23:19:58	1523	157	45.93708	-129.98627		R1012-326
23:20:20	1524	176	45.93706	-129.98623		R1012-327

Time	Z	Hdg	raw lat	raw long	R1012 Comments: '98 Lava Flow E/W Traverses (Axial)	FrGrab
23:21:50	1523	190	45.93703	-129.98619	Jumbled ropy lavas.	R1012-328
23:22:45	1523	272	45.93700	-129.98613	Still following the edge of the collapse which trends west again here.	
23:22:55	1522	267	45.93700	-129.98614	Top of a broken pillar?	R1012-329
23:23:34	1521	183	45.93704	-129.98628	Collapse edge turns to the south again.	
23:23:41	1520	171	45.93702	-129.98629	We are still on the edge of the pit; heading to 9.	R1012-330
23:24:28	1521	233	45.93695	-129.98619	A large Pillar.	R1012-331
23:25:24	1521	264	45.93688	-129.98633	Lone tiny pillar in the middle of the collapse.	R1012-332
23:27:09	1521	176	45.93690	-129.98642		R1012-333
23:27:19	1521	182	45.93688	-129.98641	Along transect between 8 and 9.	R1012-334
23:27:30	1521	188	45.93687	-129.98639	Turning south again.	
23:29:50	1520	261	45.93671	-129.98623		R1012-335
23:31:39	1517	226	45.93670	-129.98635	**Heading back to the Rumbleometer now.**	
23:32:45	1519	85	45.93671	-129.98628	Edge of the pit.	R1012-336
23:33:44	1519	85	45.93672	-129.98617	The edge of the pit as we move across.	R1012-337
23:34:45	1520	91	45.93673	-129.98602	A jelly on the side of the pit.	R1012-338
23:36:31	1520	103	45.93679	-129.98568	We are on the top of the lava flow.	R1012-339
23:36:58	1520	97	45.93675	-129.98559	We are going east pretty much back along our track line and are now back at the edge of the north-south fissure.	
23:37:37	1521	92	45.93672	-129.98549		R1012-340
23:38:32	1520	86	45.93672	-129.98535	The top edge of the pit.	R1012-341
23:39:18	1520	87	45.93673	-129.98522	Lobate roof.	R1012-342
23:39:51	1518	87	45.93674	-129.98512	Much deeper fissure.	
23:41:38	1519	87	45.93675	-129.98472	Traveling between the fissure and the main collapse heading east.	
23:42:59	1519	90	45.93679	-129.98441	More collapse and pillars.	
23:43:01	1519	89	45.93679	-129.98440	Lava pillars off on the right.	R1012-343
23:45:12	1521	92	45.93679	-129.98418	Out of the pillars and into the flat part again.	
23:45:14	1521	94	45.93679	-129.98417	Jumbled ropy lavas after the pillars on the way back to Rumble.	R1012-344
23:47:54	1523	128	45.93678	-129.98359	Ropy curvilinear lavas on the bottom; heading on Rumble.	R1012-345
23:50:19	1522	83	45.93668	-129.98322	**Back at the Rumbleometer.**	
23:50:27	1521	78	45.93669	-129.98321	We are at Rumble to recover this instrument.	R1012-346
23:51:58	1520	225	45.93676	-129.98302	The Rumbleometer.	R1012-347
23:53:49	1521	265	45.93663	-129.98311	Taking a close look at the Rumbleometer.	
23:54:51	1522	257	45.93668	-129.98321	Going to hook the end of the Rumbleometer.	
23:58:02	1521	261	45.93667	-129.98318	Grabbing the line from the front of the basket to hook onto the Rumbleometer.	
00:02:19	1521	261	45.93667	-129.98319	Grabbing the hook that we will use to lift the Rumbleometer.	
00:06:35	1521	303	45.93666	-129.98322	Crab on the Rumbleometer.	R1012-348
00:07:10	1521	295	45.93666	-129.98322	Coming in to grab the Rumbleometer and attach the hook.	
00:10:48	1520	207	45.93670	-129.98324	Still attempting to hook the Rumbleometer.	
00:15:35	1520	210	45.93669	-129.98324	Started a new DVD file.	
00:16:27	1520	211	45.93669	-129.98324	Rumbleometer is hooked.	
00:16:38	1520	209	45.93669	-129.98324	The hook is in the Rumbleometer.	R1012-349
00:19:27	1517	206	45.93668	-129.98326	Bringing ROPOS up slowly to pull the Rumbleometer loose.	
00:22:43	1517	214	45.93677	-129.98310	We are slowly reeling in the umbilical to pull Rumble loose.	
00:26:06	1517	214	45.93677	-129.98310	Still pulling up on the Rumbleometer. It is still solidly cemented on the bottom.	
00:27:53	1516	213	45.93678	-129.98310	**Rumbleometer is off the bottom!**	
00:28:47	1498	207	45.93684	-129.98309	Videos are off.	
01:26:34	1152	206	45.93693	-129.98291	Grabbing the floats off the cable.	
01:33:42	1152	206	45.93693	-129.98291	That's the last float. Now we're going to swing the crane out and get it ready for recovery.	
01:38:07	1152	206	45.93693	-129.98291	ROPOS is out of the water with the rumbleometer hanging below it.	
01:39:22	1152	206	45.93693	-129.98291	The ROPOS guys and ship crew are using boat hooks to grab the rumbleometer (which is hanging below ROPOS).	
01:43:45	1152	206	45.93693	-129.98291	Rumbleometer is on deck. Wow - those guys are impressive!	
01:58:07	1152	206	45.93693	-129.98291	ROPOS is on deck. End of the dive. That was quite the end of a dive.	

5.6.6 R1013 - ASHES (Axial)

R1013 ASHES. [R1013 Bottom time: 9/3 1619 - 9/4 0206 (9 hrs 47 min)] Fluid and biological sampling at ASHES. Took a bit of time re-acquainting ourselves with ASHES vent field, finding all the vent sites, etc. 29 samples total. Gollum: 4 HFS, 1 McLane. Mushroom: 2 HFS, 1 gas, 1 SS of blue mat. Inferno: 4 HFS, 2 gas. Hell: 2 HFS. Virgin: 3 HFS, 1 gas, 1 anhydrite piece. Recovered hobo 854 from Virgin (deployed 2004). Deployed hobo (miso) 104 at Virgin. 18 m NE of Hell: 1 worm hat grab. Phoenix: 2 SS (limpets and blue mat). Crack: 1 HFS. Marshmallow: 1 HFS. Transited along the bottom from ASHES to the caldera center. NE of ASHES: 1 SS of seds for volcaniclastic glass. Caldera center: 1 SS barnacles from the mooring line for dissolution studies. Recovered NeMO Net buoy acoustic release.

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
15:04:51	2.1	180			ROPOS is in the water.	R1013-001
15:04:59	2.1	180			DVD has started recording.	
15:19:11	87.4	179	45.93301	-130.01340	ROPOS is heading down - Nav is working better now too.	
16:19:09	1541	243	45.93335	-130.01328	At the bottom the DVCAM tape is now running.	
16:19:25	1543	244	45.93334	-130.01327	ROPOS reached the bottom.	R1013-002
16:20:08	1546	268	45.93330	-130.01329	We have spotted an old cracked glass ball on the bottom where we landed.	
16:20:19	1546	268	45.93331	-130.01330	Here is a glass ball found on the seafloor.	R1013-003
16:22:11	1545	272	45.93327	-130.01344	Heading to crack vent.	
16:22:33	1546	312	45.93327	-130.01352	We have spotted some shimmering water. It is quite diffuse.	
16:24:08	1544	242	45.93328	-130.01355	Here is a chimney.	R1013-004
16:24:08	1544	242	45.93328	-130.01355	We have come across a large active chimney. It may be ROPOS vent.	
16:25:33	1546	186	45.93328	-130.01357	There is a marker D here.	
16:26:19	1547	184	45.93327	-130.01357	Here is a bucket lid previously used as a marker.	R1013-005
16:26:40	1547	184	45.93327	-130.01357	There is a bucket lid marker and possibly an MTR. We are going to try to recover it.	
16:27:49	1547	183	45.93327	-130.01357	We have pulled out what may have been the MTR. It appears to just be a probe of some sort.	
16:29:07	1547	183	45.93326	-130.01357	Here are some limpets.	R1013-006
16:30:16	1547	183	45.93325	-130.01355	We have returned the unidentified probe to the same location.	
16:32:32	1547	142	45.93325	-130.01359	Here is a bucket lid (#21). This is not part of the NeMO experiments.	R1013-007
16:32:40	1547	142	45.93325	-130.01359	The bucket lid is number 21.	
16:33:27	1547	142	45.93325	-130.01360	The fluid sampler is having problems so we may call the dive short.	
16:35:12	1544	245	45.93323	-130.01355	A chimney - not sure which one - probably Phoenix.	R1013-008
16:36:20	1547	194	45.93327	-130.01366	There is some venting from the top of the chimney. This is by the marker 21 bucket lid and marker D.	
16:36:31	1547	194	45.93327	-130.01366	Here is the top of the chimney.	R1013-009
16:37:28	1547	194	45.93327	-130.01365	There is lots of filamentous mat present.	
16:37:57	1547	194	45.93327	-130.01365	The valve on the fluid sampler is working but the flush pump is not. We may continue the dive as we can use the McLane pump as a flush.	
16:39:54	1547	194	45.93329	-130.01365	Some bacterial filaments on the chimney.	R1013-010
16:40:14	1547	194	45.93329	-130.01365	This could be ROPOS vent or Phoenix vent - probably Phoenix.	
16:41:25	1547	193	45.93329	-130.01361	Taking a DSC mosaic of this vent.	
16:43:35	1543	208	45.93330	-130.01366	Looking around for another chimney. Another spotted to the west.	
16:44:05	1544	246	45.93333	-130.01370	This maybe Inferno and the previous chimney was Mushroom.	
16:44:21	1546	228	45.93334	-130.01377	Here is the **Inferno** chimney - we think....	R1013-011
16:46:10	1546	145	45.93336	-130.01395	Heading east towards Virgin vent.	
16:46:35	1544	60	45.93335	-130.01392	This was definitely Inferno. The first was likely **Mushroom**.	
16:48:12	1547	98	45.93344	-130.01373	This vent may be Marshmallow.	
16:48:23	1546	96	45.93344	-130.01372	More venting here and a worm hat.	R1013-012
16:50:38	1545	35	45.93348	-130.01329	We are coming up to **Virgin**.	
16:51:12	1544	66	45.93357	-130.01323	There are a few experiments in this region.	
16:51:34	1545	65	45.93361	-130.01320	Here is the Virgin chimney with the old RAS frame in front.	R1013-013
16:51:44	1545	70	45.93362	-130.01317	We are at **Virgin ven**t. There is some hot water seen here. The Hobo is covered in white material.	
16:52:45	1546	132	45.93367	-130.01313	Looking for a small vent 15m to the SW. That vent should be Gollum.	
16:53:20	1545	223	45.93366	-130.01313	Here is a settlement array.	R1013-014
16:54:18	1546	300	45.93357	-130.01316	We are at a vent about 15m away from Virgin. There is a tripod marker #21 and a bacterial trap here. Later decided **this is Gollum**.	
16:54:49	1546	302	45.93357	-130.01316	Here is the tripod marker #21.	R1013-015
16:57:44	1546	302	45.93358	-130.01320	The bacteria traps are quite over grown with limpets.	
17:00:56	1547	307	45.93350	-130.01337	Here is tripod marker #47.	R1013-016
17:01:05	1547	306	45.93350	-130.01337	We have found marker 47 and 2x? here.	
17:01:47	1547	305	45.93350	-130.01337	Here is a small vent.	R1013-017
17:04:45	1545	260	45.93346	-130.01343	Still looking around trying to get some bearings. Getting close to Mushroom.	

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
17:07:20	1545	324	45.93360	-130.01343	Here is the Marshmallow? chimney. [We were confused earlier. **This is Mushroom** (the dog. Marshmallow is a small anhydrite not a big sulfide chimney]	R1013-018
17:11:07	1545	73	45.93373	-130.01341	Passing over a floating marker #7.	
17:13:52	1537	219	45.93398	-130.01319	The Thompson headed off on the incorrect line. It is taking a little time to get back into position.	
17:17:28	1544	178	45.93381	-130.01314	We are back at Virgin and get a good fix on it.	
17:18:18	1546	205	45.93375	-130.01311	Here is the Virgin chimney.	R1013-019
17:19:10	1545	254	45.93375	-130.01311	Heading south west looking for another vent.	
17:20:21	1544	180	45.93371	-130.01325	We passed by a larval array. This is **Gollum**.	
17:21:16	1545	139	45.93363	-130.01326	Here is a larval array.	R1013-020
17:26:31	1546	141	45.93362	-130.01326	We are going to take a McLane pump sample and use the HFS sampler.	
17:27:05	1546	142	45.93362	-130.01330	Here is the next sampling site.	R1013-021
17:31:49	1546	104	45.93359	-130.01332	Looking around on Gollum vent for the most active flow.	
17:32:40	1546	104	45.93359	-130.01332	Setting up the fluid sampler at Gollum.	R1013-022
17:36:24	1546	25	45.93357	-130.01329	We have moved to the other side of Gollum vent to get a better look at the hot water.	
17:37:59	1546	25	45.93357	-130.01329	Looking for a good spot to sample fluid.	R1013-023
17:42:42	1546	25	45.93357	-130.01329	McLane pump sample. Temperature jumped to 20°C. Stopped after 4 liters. Started again at 18:02 for another 4 liter sample. Started again and stopped for a total of 20 liters. z=1545m. Gollum. **R1013-McLane-0001 (Butterfield)**	
17:43:46	1546	25	45.93357	-130.01329	HFS piston sample #1. Taken at the same time as the McLane pump sample. Tmax=20.4°C; T2=12.2°C; Endtime=17:46. Stopped early as it may not have triggered well. z=1545m. Sample didn't work. Gollum. **R1013-HFS-0002 (Butterfield)**	
17:47:50	1546	25	45.93357	-130.01329	HFS Unfiltered bag #12. Tmax=32.2°C; Tavg=29.3°C; Vol=596ml; Endtime=17:51.30. T1 jumped so it is definitely working. z=1545m. Gollum. **R1013-HFS-0003 (Butterfield)**	
17:54:02	1546	25	45.93355	-130.01329	HFS Filtered Piston #5. Tmax=29.5°C; Tavg=26.0°C; Vol=800ml; Endtime=18:00.30. It also seems to be working. z=1545m. Gollum. **R1013-HFS-0004 (Butterfield)**	
18:02:19	1546	25	45.93359	-130.01323	Here are some tube worms and maybe some snails.	R1013-024
18:03:56	1546	25	45.93358	-130.01323	HFS DNA Filter #18. Tmax=29.8°C; Tavg=24.6°C; T2=12°C; Vol=2321ml; Endtime=18:20. z=1545m. Gollum. **R1013-HFS-0005 (Butterfield)**	
18:05:11	1546	25	45.93358	-130.01323	Here is a sea spider (pycnogonid).	R1013-025
18:06:22	1546	25	45.93359	-130.01323	Here is an anemone.	R1013-026
18:22:24	1546	25	45.93359	-130.01323	Done sampling here. Some adjustments need to be made with the wand and tubing to allow the purse to close.	
18:24:35	1546	25	45.93359	-130.01323	New DVCAM tape started.	
18:25:01	1546	25	45.93358	-130.01323	Heading to Mushroom vent.	
18:25:30	1546	34	45.93358	-130.01324	The settlement array is in line with Virgin vent.	
18:26:09	1544	263	45.93359	-130.01321	A bunch of little tripod markers bearing 290 from Gollum vent.	
18:27:21	1543	317	45.93361	-130.01341	This vent is **Mushroom**. It looks more like a terrier now. This is the vent we thought was Marshmallow earlier.	
18:28:03	1545	332	45.93366	-130.01350	There is some blue mat on the snout of the vent.	
18:30:00	1545	258	45.93370	-130.01343	Here are some blue mats on the Mushroom vent.	R1013-027
18:31:45	1546	6	45.93360	-130.01351	Looking for a lower spot to sample around Mushroom.	
18:32:28	1546	37	45.93361	-130.01356	This is the base of the Mushroom vent.	R1013-028
18:33:13	1547	53	45.93363	-130.01358	Here is some good flow. We are going to break off the tip and hopefully sample here.	
18:33:21	1547	53	45.93363	-130.01358	Here are some good flows.	R1013-029
18:35:07	1547	53	45.93362	-130.01358	This is the sampling location at Mushroom's vent.	R1013-030
18:39:18	1547	53	45.93362	-130.01358	Lots of sulfide worms around this chimney.	
18:39:54	1547	53	45.93362	-130.01358	Sulfide worms fighting.	R1013-031
18:43:50	1547	52	45.93362	-130.01358	Running a quick flush with the McLane pump.	
18:46:03	1547	52	45.93362	-130.01358	HFS unfiltered piston sample #2. Tmax=80.5°C; Tavg=58.3°C; T2=40.0°C; Vol=800 ml; Endtime=1851. The piston is moving - that's good. z=1547. Base of Mushroom. **R1013-HFS-0006 (Butterfield)**	
18:49:27	1547	52	45.93362	-130.01358	Gastight #4 hydraulic line 4. Temp 64°C. Start 1850. z=1547. Base of Mushroom. **R1013-gas-0007 (Evans)**	
18:52:42	1547	52	45.93362	-130.01358	HFS filtered bag #7. Tmax=62°C; Tavg=56°C; Vol=587ml; Endtime=1858. z=1547 Temp is probably close to 300°C. Lots of seawater entrained so temp is inaccurate. Base of Mushroom. **R1013-HFS-0008 (Butterfield)**	
18:53:39	1547	52	45.93362	-130.01358	Sampling fluids from Mushroom.	R1013-032
18:57:09	1547	52	45.93362	-130.01358	Still sampling at Mushroom vent - currently taking HFS#7 filtered bag.	R1013-033
19:01:55	1547	52	45.93362	-130.01358	We're going to suction blue mat here and then we will head to Inferno. Have to be quick because we're running behind schedule.	

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
19:02:52	1547	52	45.93362	-130.01358	Dave says there is some blue mat on the "nose of the dog". It really looks like a big nose. **Mushroom is 2-3 meters high covered in lots of worms. There are several chimneys at the top that looks like dog ears. Also a small anhydrite complex at its base.**	
19:03:34	1545	358	45.93360	-130.01355	The base of Mushroom.	R1013-034
19:04:38	1544	267	45.93395	-130.01322	"Dog ears" at the top of Mushroom. Preparing to sample blue mat.	R1013-035
19:05:32	1546	302	45.93391	-130.01322	Looks like there is a small chimney off to the side of Mushroom as well with very small spires. It's maybe 0.5 meters tall.	
19:06:15	1547	281	45.93392	-130.01324	Going to sample blue mat at the base of Mushroom under the nose (200 micron double mesh) into jar #3	
19:07:22	1546	282	45.93392	-130.01324	This area will suction sampled for blue mat.	R1013-036
19:08:14	1547	292	45.93392	-130.01324	Snapping a couple DSCs of the base of Mushroom where we will suction blue mat.	
19:08:53	1547	292	45.93392	-130.01324	The base here is another small anhydrite-type chimney.	
19:09:18	1547	292	45.93392	-130.01324	Suctioning blue mat at the base of Mushroom under the nose (200 micron double mesh) into jar #3. The base is a small anhydrite complex (~0.5 meters tall with several chimneys). z=1547. Base of Mushroom. **R1013-SS-0009 (Kouris)**	
19:10:09	1547	292	45.93392	-130.01324	Suction sampling into jar #3.	R1013-037
19:11:47	1547	292	45.93351	-130.01349	Jar #3 after sampling.	R1013-038
19:12:54	1547	292	45.93352	-130.01348	The sample site at the base of Mushroom.	R1013-039
19:13:53	1546	305	45.93353	-130.01350	Off to the nose to get some shots of the blue mat there.	
19:14:19	1544	288	45.93358	-130.01350	There's blue mat on the top of the "nose" flange. It's covered in worms.	
19:15:07	1545	287	45.93359	-130.01351	Mushroom	R1013-040
19:15:24	1544	247	45.93362	-130.01351	This is Mushroom.	R1013-041
19:16:57	1542	207	45.93360	-130.01363	Now we're at Inferno.	R1013-042
19:19:56	1545	57	45.93352	-130.01372	We have reached Inferno.	R1013-043
19:20:19	1546	71	45.93354	-130.01373	Inferno.	R1013-044
19:20:49	1545	135	45.93359	-130.01373	We're at Inferno now. There's a weird triangular marker at the bottom and beehives at the top.	
19:21:05	1544	186	45.93361	-130.01368		R1013-045
19:21:11	1544	198	45.93361	-130.01366	Lots of beehives at the top of this huge structure - Inferno.	R1013-046
19:21:29	1544	210	45.93361	-130.01364	Lots of beehives at the top of this huge structure.	
19:21:35	1544	219	45.93361	-130.01364	Top chimneys at **Inferno**.	R1013-047
19:21:53	1544	215	45.93361	-130.01363	Inferno is covered in worms - lots of beehives. We're taking DSCs and lots of framegrabs.	
19:22:06	1543	230	45.93361	-130.01362	Inferno.	R1013-048
19:24:32	1544	292	45.93356	-130.01364	Top chimney at Inferno.	R1013-049
19:26:29	1544	290	45.93357	-130.01364	Taking the temp here in this beehive. Got DSCs of this beehive at toward the top. The beehive just fell off.	
19:26:34	1544	290	45.93357	-130.01364	Probing temperature of chimney.	R1013-050
19:27:31	1544	290	45.93357	-130.01364	Probing temperature of chimney after a piece has broken off.	R1013-051
19:27:55	1544	290	45.93357	-130.01364	Going for another beehive close by on Inferno.	
19:31:13	1544	303	45.93356	-130.01364	The sub has been wiggling a bit. We got up to almost 180C on the first poke. Going to get the wand and try again.	
19:32:16	1544	301	45.93356	-130.01364	Measuring temperature after stabilizing ROPOS.	R1013-052
19:32:28	1544	301	45.93356	-130.01364	Probe in the flow of this beehive near the top of Inferno.	
19:37:49	1544	305	45.93356	-130.01363	Seems like we're having difficulty positioning the sub so that it is stable for sampling.	
19:41:56	1544	307	45.93356	-130.01364	We're still trying to get a good stable position for sampling. Going to use the stbd arm to help lock the sub in.	
19:42:30	1544	306	45.93356	-130.01364	Stabilizing the sub with the stbd arm.	R1013-053
19:43:31	1544	307	45.93356	-130.01364	Looks like we will attempt this again now.....hope hope	
19:43:59	1544	307	45.93356	-130.01364	Looks like we are stable now. Can see the opening too. Temp is increasing.	
19:44:06	1544	307	45.93356	-130.01364	Measuring the temperature again.	R1013-054
19:45:13	1544	306	45.93356	-130.01364	Those beehives are really fragile. Temp is 200 +. Looks good here.	
19:46:13	1544	306	45.93356	-130.01364	Temp is going up 292° on the front.	
19:46:22	1544	306	45.93356	-130.01364	Measuring temperatures up to 295°C.	R1013-055
19:46:43	1544	306	45.93356	-130.01364	Temp is up to 295°C on the front.	
19:47:29	1544	306	45.93356	-130.01364	Sulfide worms and tube worms hanging out here in the flow.	
19:47:52	1544	306	45.93356	-130.01364	HFS filtered bag #8. In a beehive toward the top of Inferno. Tmax=284°C; Tavg=278°C; T2=120°C; Vol=460ml; Endtime=1950:54. z=1544m. Because of the heat the manifold is flushing itself. Inferno beehive. **R1013-HFS-0010 (Butterfield)**	
19:48:48	1544	306	45.93356	-130.01364	The manifold is flushing itself without the flush pump.	R1013-056
19:52:01	1544	306	45.93356	-130.01364	Gastight #6 Hydraulic line 3. Tmax was 284C. In the beehive where previous HFS was taken. Z=1544m. Inferno beehive. **R1013-gas-0011 (Evans)**	

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
19:52:49	1544	306	45.93356	-130.01364	Hydraulic oil leak on the gastight line.	R1013-057
19:54:03	1544	306	45.93356	-130.01364	Highlights on here at Inferno.	
19:54:16	1544	306	45.93356	-130.01364	HFS unfiltered piston #3. Same place as last sample. Tmax=274°C; Tavg=268°C; T2=25°C; Vol=645ml; Endtime=1958 z=1544m. Inferno beehive. **R1013-HFS-0012 (Butterfield)**	
19:59:36	1544	306	45.93356	-130.01364	Moving the intake a bit to get a higher temp.	
20:00:45	1544	306	45.93356	-130.01364	Moved that beehive out of the way.	
20:01:02	1544	306	45.93356	-130.01364	Most of the chimlet has broken off now - and we are probing for a higher temperature.	R1013-058
20:02:46	1544	309	45.93356	-130.01364	Highlights were turned off at 1956.	
20:04:06	1544	311	45.93356	-130.01364	We're over 300°C here.	
20:04:24	1544	311	45.93356	-130.01364	We're up to 307°C here.	
20:04:42	1544	311	45.93356	-130.01364	Gastight #2 hydraulic line 2. Fired at 2005. Temp is ~307°C Temp was 245°C during sampling. Z=1544. Inferno. **R1013-gas-0013 (Evans)**	
20:06:28	1544	311	45.93356	-130.01364	HFS unfiltered bag #13. In this huge flow out of a broken off beehive. Tmax=260°C; Tavg=249°C; T2=20°C; Vol=433ml; Endtime=2009 z=1544m. Inferno. **R1013-HFS-0014 (Butterfield)**	
20:07:09	1544	311	45.93356	-130.01364	Sulfide worms near the 300 deg-C fluid of this smoker (Inferno).	R1013-059
20:09:17	1544	311	45.93356	-130.01364	Overview of the chimney with worms during sampling at Inferno.	R1013-060
20:10:45	1544	311	45.93356	-130.01364	Attempting to push the probe way down into the beehive for another temp reading.	
20:16:39	1544	306	45.93356	-130.01364	HFS unfiltered bag #14. Tmax=300 Tavg=295 Vol=500ml. Endtime=2020:20 z=1544. This sample didn't work. Inferno beehive area. **R1013-HFS-0015 (Butterfield)**	
20:23:02	1544	306	45.93356	-130.01364	Stowing the sampler. Will take a piece of beehive chimney for Francoise.	
20:24:38	1544	306	45.93356	-130.01364	Going to grab a piece of the broken beehive chimney for Francoise - but it just breaks up and turns to dust when they grab it. Looking at another piece. Too fragile. We're going to forget this.	
20:25:00	1544	306	45.93356	-130.01364	Sampling a piece of the broken off sulfide. Sample was unsuccessful	R1013-061
20:27:16	1544	305	45.93356	-130.01364	We're going to go to Hell vent next.	
20:28:42	1543	291	45.93356	-130.01364	Snapping some images of Inferno as we leave. A couple DSCs and several framegrabs.	
20:28:44	1543	292	45.93356	-130.01364	Leaving Inferno.	R1013-062
20:28:52	1542	300	45.93355	-130.01363		R1013-063
20:29:14	1540	269	45.93357	-130.01359	**Leaving Inferno.**	R1013-064
20:29:25	1540	247	45.93360	-130.01359	Backing away from Inferno.	R1013-065
20:29:41	1540	202	45.93363	-130.01365	Inferno.	R1013-066
20:29:45	1540	193	45.93364	-130.01367	A last look at Inferno.	R1013-067
20:30:39	1543	212	45.93354	-130.01384	Traveling over pillows and lobate flows on our way to Hell. Lots of sediment cover here (probably mostly hydrothermal).	
20:30:56	1546	207	45.93347	-130.01388	Lobate flows.	R1013-068
20:31:08	1545	209	45.93342	-130.01390	**Hell**	R1013-069
20:31:13	1545	207	45.93341	-130.01390	Toward the top of Hell.	R1013-070
20:31:15	1546	204	45.93340	-130.01391	The base of Hell.	R1013-071
20:31:20	1547	203	45.93340	-130.01391		R1013-072
20:31:50	1546	180	45.93338	-130.01395	We're at **Hell chimney. Little square foam markers at the base of Hell (#2 and L)**. Very small smoker down low. This is more like a rounded ball at the top with lots of smaller chimneys at the top.	
20:32:21	1541	173	45.93339	-130.01397	The top of Hell. It's about 4 meters high.	R1013-073
20:32:38	1542	201	45.93339	-130.01391	The top of Hell.	R1013-074
20:32:51	1542	227	45.93337	-130.01386	Near the top of Hell.	R1013-075
20:33:00	1542	253	45.93334	-130.01384		R1013-076
20:33:06	1542	261	45.93333	-130.01384	Middle Hell.	R1013-077
20:33:11	1542	274	45.93331	-130.01384		R1013-078
20:33:20	1542	293	45.93329	-130.01385		R1013-079
20:33:35	1542	333	45.93325	-130.01390		R1013-080
20:34:05	1543	82	45.93330	-130.01403	There's a bit of blue mat here too. **This chimney is a bit wider at the top then Inferno.**	
20:35:00	1545	126	45.93335	-130.01402	Hell.	R1013-081
20:35:36	1545	330	45.93326	-130.01391	We're looking around the top of Hell now. Snapping some DSCs.	
20:35:52	1543	307	45.93328	-130.01388	Top of Hell.	R1013-082
20:36:13	1542	285	45.93330	-130.01386	Getting a bunch of DSCs here.	
20:38:00	1543	276	45.93332	-130.01391	Venting out of the top of Hell	R1013-083
20:38:52	1543	284	45.93332	-130.01391	Venting out of the top of Hell.	R1013-084
20:40:31	1543	293	45.93331	-130.01391	Preparing to sample Hell. This nice beehive.	
20:41:35	1543	283	45.93332	-130.01391	Fluid sampling top of Hell.	R1013-085

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
20:42:51	1543	287	45.93331	-130.01391	Fluid sampling near the Top of Hell.	R1013-086
20:43:53	1543	282	45.93332	-130.01391	Moving the DSCs	
20:44:13	1543	282	45.93332	-130.01391	Preparation for fluid sampling near top of Hell.	R1013-087
20:45:52	1543	280	45.93332	-130.01391	Steady temp of 280°C.	
20:47:37	1543	280	45.93332	-130.01391	HFS bag #11. Here at Hell in this beehive surrounded by biota. Tmax=127°C; Tavg=111°C; Vol=549ml; Endtime=2051:30 z=1543m. The sampler fixed itself. The flush pump works. Hell - beehive near the top. **R1013-HFS-0016 (Butterfield)**	
20:52:54	1543	280	45.93332	-130.01391	The flush pump fixed itself. Yippee.	
20:54:45	1543	280	45.93332	-130.01391	Meanwhile - back at the vent.... Can't see anything through all the shimmering water.	
20:55:16	1543	280	45.93332	-130.01391	Fluid sampling of Hell.	R1013-088
20:55:51	1543	280	45.93332	-130.01391	HFS unfiltered piston #4. Tmax=105°C; Tavg=93°C; T2=~30°C; Vol=811ml; Endtime=2101 z=1543m. Hell - beehive near the top. **R1013-HFS-0017 (Butterfield)**	
21:02:41	1543	280	45.93332	-130.01390	We're finished here. We're going to stow the arm now and head over to Virgin vent. First we will look for "worm hats" for Jonathan.	
21:05:01	1543	287	45.93331	-130.01390	We're going to look around a bit for worm hats. If we find them we will come back later to pick it up.	
21:05:46	1543	283	45.93332	-130.01389	Leaving the site.	R1013-089
21:06:04	1544	278	45.93332	-130.01388	Taking some digitals and frame grabs of Hell.	
21:08:11	1546	15	45.93326	-130.01390	Anemones in the tubeworm bush. Looking for a tall cylindrical worm bush. Looks like a hat??	
21:08:52	1546	302	45.93324	-130.01391	Tubeworm patches.	R1013-090
21:09:45	1545	37	45.93328	-130.01387	This might be a worm hat.	R1013-091
21:10:22	1547	37	45.93329	-130.01386	Not quite a worm hat.	R1013-092
21:10:44	1547	37	45.93329	-130.01386	Worm hats are like a column of worms.	
21:11:41	1545	33	45.93333	-130.01380	Could this be a worm hat?	R1013-093
21:12:00	1546	54	45.93337	-130.01380	That's a quite a bush growing straight up... That's pretty close to a "worm hat". Going to shake it a bit.	
21:12:06	1546	45	45.93338	-130.01381	Worm hat	R1013-094
21:13:11	1546	87	45.93343	-130.01380	A close-up of the worm hat.	R1013-095
21:13:31	1547	93	45.93344	-130.01380	It's like hollow inside and they capture the warm water and it comes up the center. That's a definite "worm hat".	
21:13:51	1547	93	45.93344	-130.01380	After poking at it - Dave decides that this is indeed a worm hat.	R1013-096
21:14:19	1547	93	45.93344	-130.01380	We're heading to Virgin next.	
21:15:22	1543	43	45.93353	-130.01357	Back at Mushroom.	R1013-097
21:15:42	1545	16	45.93355	-130.01352	We're looking at the back side of the "dog" Mushroom....	
21:16:20	1545	44	45.93357	-130.01343	We're on the way to Virgin.	
21:16:56	1544	70	45.93362	-130.01333	Virgin in the distance.	R1013-098
21:17:08	1545	75	45.93362	-130.01328	There's a Virgin in distance. The RAS frame is right next to her.	
21:17:12	1545	75	45.93362	-130.01327	Approaching **Virgin**.	R1013-099
21:17:54	1545	123	45.93368	-130.01318	First task is to get the hobo out of the vent.	
21:18:33	1546	169	45.93369	-130.01312	Preparing to work at Virgin.	R1013-100
21:19:11	1546	169	45.93369	-130.01312	There are a couple little square markers here too.	
21:19:55	1546	169	45.93369	-130.01312	HOBO covered with bacterial mat.	R1013-101
21:20:09	1546	169	45.93370	-130.01313	"Bag creatures" here too. The squares are markers from the hobo probe.	
21:21:13	1546	169	45.93370	-130.01313	We see the temp intake wand here and a bit of other hardware.	
21:21:13	1546	169	45.93370	-130.01313	Intake nozzle.	R1013-102
21:21:46	1546	169	45.93370	-130.01313	The hobo must have gotten knocked out when the tripod was recovered in 2005.	
21:22:19	1546	169	45.93370	-130.01313	Recovering the HOBO.	R1013-103
21:22:29	1546	169	45.93370	-130.01314	Recovering the HOBO.	R1013-104
21:22:32	1546	169	45.93370	-130.01314	**RECOVERED the hobo (#854)** - deployed in 2004 - at Virgin. It was knocked out of the vent when the tripod was recovered in 2005.	
21:24:31	1546	169	45.93370	-130.01313	The top came off (whoops says Big Keith).	
21:24:39	1546	169	45.93370	-130.01313	Measuring the temperature at Virgin.	R1013-105
21:25:11	1546	169	45.93370	-130.01313	Taking the temp here. The chimney has crumbled. Lots of chunks of anhydrite at the base. Francoise will sample them.	
21:25:17	1546	169	45.93370	-130.01313	While measuring the temperature...	R1013-106
21:27:44	1546	169	45.93370	-130.01314	Measuring the temperature.	R1013-107
21:27:51	1546	169	45.93370	-130.01314	The temp is reading 240°C	
21:28:53	1546	169	45.93370	-130.01314	HFS filtered piston #6. Tmax=244°C; Tavg=235°C; T2=100°C; Vol=469ml; Endtime=2131:30 z=1546m. The chimney has fallen and we're sampling the base. Virgin. **R1013-HFS-0018 (Butterfield)**	

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
21:32:34	1546	169	45.93370	-130.01314	Gastight #7 hydraulic channel #1. Same spot as previous sample. T=248C. Start 2133:20. z=1526m. The chimney has fallen and we're sampling the base. Virgin. **R1013-gas-0019 (Evans)**	
21:34:30	1546	169	45.93370	-130.01314	Virgin after sampling.	R1013-108
21:34:36	1546	169	45.93370	-130.01314	Nice view of the sampling site at Virgin.	
21:35:21	1546	169	45.93370	-130.01314	HFS filtered bag #9. Tmax=248.7°C; Tavg=244.7°C; T2=117°C; Vol=273ml; Endtime=2136:50 z=1546m. Virgin. **R1013-HFS-0020 (Butterfield)**	
21:38:22	1546	169	45.93370	-130.01314	HFS filtered bag #10. Tmax=252.3°C; Tavg=248°C; T2=113°C; Vol=339ml; Endtime=2142:40 z=1546m. Virgin. **R1013-HFS-0021 (Butterfield)**	
21:43:28	1546	169	45.93370	-130.01314	That's it for fluid sampling at Virgin.	
21:44:46	1546	169	45.93370	-130.01314	Preparing to **deploy the new hobo (miso) #104 here** to continue the temperature time series at Virgin.	
21:46:41	1546	169	45.93370	-130.01314	The fluid sampler is all full - no more hot water sampling today (but more diffuse sampling to follow).	
21:47:45	1546	169	45.93370	-130.01313	Inserting new HOBO.	R1013-109
21:48:13	1546	169	45.93370	-130.01313	Attempting to deploy hobo (miso) #104 at Virgin. - Not yet. Will stow the old one first and then get an anhydrite sample.	
21:52:08	1546	169	45.93370	-130.01313	Stowing the old HOBO.	R1013-110
21:52:22	1546	169	45.93369	-130.01313	***The NAV OFFSET here is 20 meters east of navigation in previous years.***	
21:52:55	1546	169	45.93369	-130.01313	Going to have to carry the hobo up in the arm because of the floats on the end.	
21:53:18	1546	169	45.93369	-130.01313	Want to stuff some anhydrite chunks in the purse now.	
21:55:11	1546	168	45.93369	-130.01313	Trying to grab the anhydrite with the claw.	
21:55:35	1546	168	45.93370	-130.01313	Attempting to sample the anhydrite.	R1013-111
21:56:11	1546	167	45.93370	-130.01313	The anhydrite at Virgin crumbles pretty easily. We're going to have to suction it. We will drop the pieces in the purse with the suction sampler.	
21:58:30	1546	167	45.93370	-130.01313	Attempting to sample the anhydrite pieces with the suction sampler.	R1013-112
21:59:02	1546	167	45.93370	-130.01313	Suctioning the anhydrite up (the flush bottle #8 is at the end) and then dropping it in the purse. Got one small piece of anhydrite. One larger angular piece with sulfide. A couple small fresh pieces from the top. Z=1546. Virgin. **R1013-anhydrite-0022 (Labonte)**	
22:02:53	1546	167	45.93370	-130.01313	One little piece of anhydrite dropped into the purse.	R1013-113
22:04:52	1546	159	45.93370	-130.01313	Anhydrite with sulfide - sample.	R1013-114
22:06:48	1546	159	45.93370	-130.01313	We are using the suction hose to collect anhydrite samples.	R1013-115
22:07:53	1546	159	45.93370	-130.01313	Finished sampling. Checking gauges. Will deploy the hobo next.	
22:08:23	1546	159	45.93370	-130.01313	Sample #22 is an anhydrite sample from Virgin.	R1013-116
22:09:32	1546	159	45.93370	-130.01313	Closing up the purse.	
22:10:39	1546	159	45.93370	-130.01313	Deploying HOBO (MISO)#104. It fell out. Needs a bit of re-arranging.	
22:10:43	1546	159	45.93370	-130.01313	Inserting the new HOBO sampler; called a MISO.	R1013-117
22:12:28	1546	159	45.93370	-130.01313	Keith is "customizing" the MISO.	
22:12:55	1546	159	45.93370	-130.01313	It's lying down on its side.	
22:14:24	1546	117	45.93368	-130.01315	Repositioning it again. Looks like it is in the right spot.	
22:14:41	1546	117	45.93368	-130.01315	Inserting the MISO.	R1013-118
22:15:41	1546	117	45.93368	-130.01315	That looks good. Hobo (MISO) 104 deployed at Virgin.	
22:15:41	1546	117	45.93368	-130.01315	MISO positioned.	R1013-119
22:17:22	1546	129	45.93368	-130.01316	Next going to grab the old hobo and the titanium tube from 2004 RAS. Then will grab a worm hat.	
22:18:27	1545	243	45.93369	-130.01308	Another view of the MISO position.	R1013-120
22:18:58	1546	249	45.93369	-130.01308	Grabbed the titanium tube. It's hollow. Putting it in the purse.	
22:19:38	1546	249	45.93369	-130.01308	Recovering titanium nozzle.	R1013-121
22:20:38	1546	249	45.93369	-130.01308	Just want to get a "piece of junk" off of the seafloor (the titanium tube).	
22:22:43	1546	246	45.93369	-130.01306	Attempting (again) to place the titanium tube in the purse.	
22:24:49	1546	247	45.93369	-130.01306	Placing the nozzle in the bag.	R1013-122
22:25:09	1546	247	45.93369	-130.01306	It's in there! Closing up the bag now.	
22:26:11	1546	247	45.93369	-130.01306	Going to try to get Jonathan's worm hat next.	
22:28:43	1545	249	45.93351	-130.01340	Looking around for a "worm hat".	
22:29:01	1545	246	45.93349	-130.01344	Worm hat found.	R1013-123
22:29:15	1545	252	45.93348	-130.01351	That looks like a Dr. Seuss hat - or perhaps Abe Lincoln's stove pipe hat.	
22:30:00	1547	253	45.93346	-130.01359	We're going to make a grab of this "worm hat". We want alvinellid worms. Will first do some purse maintenance.	
22:30:02	1547	252	45.93346	-130.01359	Preparing to sample the worm hat.	R1013-124
22:33:33	1547	252	45.93345	-130.01366	Close-up of the worm hat.	R1013-125
22:34:33	1547	252	45.93345	-130.01366	Sampling the worm hat.	R1013-126
22:34:46	1547	252	45.93345	-130.01366	Grab of this "worm hat". We want alvinellid worms. Got quite a large batch of the worms from the top of the hat. Lots of it still remains on the seafloor in good shape. z=1547m. 18 m NE of Hell - in Wormhat. **R1013-bio-0023 (Rose)**	
22:34:52	1547	252	45.93345	-130.01366	Sampling the worm hat.	R1013-127

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
22:35:40	1547	252	45.93345	-130.01366	Storing the sample.	R1013-128
22:37:21	1547	253	45.93345	-130.01366	The worm hat sample half in the purse.	R1013-129
22:38:32	1547	253	45.93345	-130.01366	Trying to shove these worms in the purse. That's quite the feat.	
22:38:35	1547	253	45.93345	-130.01366	Stuffing the worms in the bag.	R1013-130
22:47:37	1545	193	45.93344	-130.01365	Moving away from the worm hat and looking around.	
22:48:31	1546	182	45.93333	-130.01364	There are 2 markers here. Marker D and marker 7. **This is Phoenix.**	
22:48:48	1546	195	45.93330	-130.01364	Base of Phoenix.	R1013-131
22:49:54	1546	213	45.93329	-130.01363	Going to do some suction sampling here at Phoenix.	
22:49:57	1546	215	45.93329	-130.01363	Tubeworms that adorn the base of Phoenix.	R1013-132
22:50:07	1546	221	45.93328	-130.01362		R1013-133
22:50:25	1547	236	45.93327	-130.01361	Underside of Phoenix.	R1013-134
22:51:06	1547	237	45.93327	-130.01362	Another shot of the underside and base of Phoenix.	R1013-135
22:51:19	1547	238	45.93327	-130.01362	Settling down at the base of the structure for limpet suctioning.	
22:52:30	1547	232	45.93327	-130.01361	Suctioning limpets off of Phoenix into jar 1.	R1013-136
22:52:57	1547	233	45.93327	-130.01361	Suctioning limpets into jar #1 with 180 micron mesh. Taken in a dense tubeworm bush. Z=1547. Base of Phoenix. **R1013-SS-0024 (Rose)**	
22:54:30	1547	230	45.93327	-130.01361	Still suctioning limpets.	R1013-137
22:55:05	1547	228	45.93327	-130.01361	We are done suctioning for limpets.	R1013-138
22:55:55	1547	243	45.93327	-130.01361	We are retrieving the Hobo.	R1013-139
22:56:22	1547	232	45.93327	-130.01361	Side of Phoenix.	R1013-140
22:56:32	1547	229	45.93328	-130.01362	Looking around the structure for some blue mat to suction.	
22:57:02	1546	189	45.93329	-130.01365	Water coming out of side of Phoenix.	R1013-141
22:57:23	1546	150	45.93328	-130.01369	There is a large flow hot jet mid way up the structure.	
22:57:53	1546	106	45.93325	-130.01372	We have discovered blue mats!	R1013-142
22:58:50	1547	123	45.93326	-130.01371	Taking some DSCs of the blue mat colonies before we suction.	
23:00:36	1547	123	45.93326	-130.01370	We are moving into position to suction into jar four.	R1013-143
23:00:59	1547	124	45.93326	-130.01370	Pretty blue mats.	R1013-144
23:01:18	1547	125	45.93326	-130.01370	Suctioning blue mats into jar #4 with a 200 micron double mesh sieve. Z=1547. Taken from the NW side of Phoenix near the base. **R1013-SS-0025 (Kouris)**	
23:01:48	1547	125	45.93326	-130.01370	We are flushing into jar 8.	R1013-145
23:03:08	1547	126	45.93326	-130.01370	We are suctioning the blue mat into the jar.	R1013-146
23:03:57	1547	126	45.93326	-130.01370	We are still suctioning blue mat.	R1013-147
23:05:27	1547	126	45.93326	-130.01370	We are examining the quantity of blue mats that we have collected.	R1013-148
23:07:40	1547	224	45.93327	-130.01362	We are retrieving the hobo.	R1013-149
23:08:00	1547	225	45.93327	-130.01362	Picking up the hobo again and heading east to take another diffuse fluid DNA filter.	
23:09:38	1547	205	45.93328	-130.01359	**Marker 21** here but we can't figure out where exactly we are. **Probably at a site dubbed Styx several years ago.**	
23:10:05	1547	210	45.93327	-130.01359	Marker 21 laying on the seafloor at an unknown vent.	R1013-150
23:11:50	1546	3	45.93331	-130.01354	We are heading east.	R1013-151
23:12:29	1544	124	45.93334	-130.01349	We think we see the cement box just ahead.	
23:12:47	1545	112	45.93332	-130.01340	We have discovered the box; with a glass ball beside it.	R1013-152
23:12:50	1545	122	45.93332	-130.01340	Broken glass ball.	
23:13:58	1546	171	45.93334	-130.01330	We are examining the box.	R1013-153
23:14:38	1546	220	45.93333	-130.01326	This is Paul Johnson's cement box complete with flow meter.	
23:15:35	1546	111	45.93331	-130.01333	There is a wee bit of venting at the crack near to the box.	R1013-154
23:16:03	1546	111	45.93331	-130.01333	Going to take another DNA filter here at **Crack**.	
23:19:00	1546	111	45.93331	-130.01333	Picking up the HFS sample wand to check fluid temperatures and sample.	
23:19:04	1546	111	45.93331	-130.01333	We are getting ready to sample at Crack.	R1013-155
23:20:51	1546	111	45.93331	-130.01333	We are sampling for DNA. Lots of flock from the vent.	R1013-156
23:21:56	1546	111	45.93330	-130.01333	HFS Sterivex filter #22. Tmax=50.6 Tavg=49 T2=33 Vol=3010ml. Z=1546. Taken at the base of Paul Johnson's cement box with flow meter. Temperature is very stable. Crack Vent. **R1013-HFS-0026 (Butterfield)**	
23:22:02	1546	111	45.93330	-130.01333	We have begun sampling.	R1013-157
23:24:35	1546	111	45.93330	-130.01333	A strange bit of debris.	R1013-158
23:28:38	1546	111	45.93330	-130.01334	Sign decorated by the Bos'n on the Ron Brown.	R1013-159
23:31:05	1546	111	45.93330	-130.01334	Another little vent.	R1013-160
23:32:07	1546	111	45.93330	-130.01334	We are still sampling.	R1013-161
23:35:08	1546	111	45.93330	-130.01334	Still collecting a DNA sample.	R1013-162
23:40:08	1546	110	45.93330	-130.01334	Still sampling.	R1013-163
23:43:28	1546	110	45.93330	-130.01334	Done fluid sampling here. We are going to go look at the message we spotted off in the distance.	
23:43:46	1546	110	45.93330	-130.01334	We are finished sampling.	R1013-164
23:44:56	1546	84	45.93331	-130.01332	A sponge garden to the northwest of Crack.	R1013-165
23:45:37	1546	93	45.93336	-130.01321	We are retrieving the flag marker.	R1013-166
23:46:16	1546	93	45.93336	-130.01321	The top side of the hand drawn marker.	R1013-167

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
23:47:40	1546	92	45.93336	-130.01321	Some sponges near the marker.	R1013-168
23:47:49	1546	92	45.93336	-130.01321	We have just turned it over to look at the other side.	R1013-169
23:47:57	1546	92	45.93336	-130.01321	The other side of the hand-drawn marker.	R1013-170
23:48:53	1546	92	45.93336	-130.01321	We are replacing the flag/marker (previously called a cup marker).	R1013-171
23:49:08	1546	103	45.93336	-130.01321	Had a look at the bottom artwork from the Boson on the Brown and replaced it for posterity.	
23:50:05	1545	309	45.93340	-130.01320	Heading northwest to find another diffuse vent to sample for DNA.	
23:51:43	1545	4	45.93355	-130.01353	We are back at Mushroom and continuing on to Marshmallow.	
23:51:48	1545	19	45.93357	-130.01353	We've just passed Mushroom.	R1013-172
23:52:31	1545	34	45.93363	-130.01344	Marker 1 or "I".	R1013-173
23:52:31	1545	34	45.93363	-130.01344	Marker 1 or I between Mushroom and Marshmallow.	
23:53:45	1544	88	45.93366	-130.01334	Virgin.	R1013-174
23:55:56	1545	88	45.93372	-130.01327	Wandering around trying to find Marshmallow.	
23:56:58	1544	229	45.93369	-130.01345	We have returned to Mushroom in our search for Marshmallow.	R1013-175
00:00:12	1546	114	45.93366	-130.01354	Still homing in on Marshmallow.	
00:00:22	1545	115	45.93365	-130.01349	We are still searching for Marshmallow and are en route to find Gollum to orient ourselves.	R1013-176
00:00:44	1545	134	45.93363	-130.01341	We have found the array and are orienting ourselves to find Marshmallow.	R1013-177
00:01:21	1545	193	45.93360	-130.01331	This is Gollum.	R1013-178
00:02:16	1545	348	45.93361	-130.01336	**We have identified Marshmallow next to marker the "I" or "1" that we identified earlier.**	R1013-179
00:02:22	1545	350	45.93362	-130.01337	We found **Marshmallow and it is still small**. What saw earlier that we thought was Marshmallow must have been the back side of Mushroom?	
00:03:48	1546	26	45.93365	-130.01341	Bacterial mat at Marshmallow.	R1013-180
00:04:38	1546	26	45.93365	-130.01341	We are sampling.	R1013-181
00:05:32	1546	26	45.93365	-130.01341	HFS Sterivex filter #21. Tmax=106.8 Tavg=96.8 T2=65 vol=2154 mls Z=1546. Marshmallow. **R1013-HFS-0027 (Butterfield)**	
00:07:10	1546	26	45.93360	-130.01333	We are still sampling.	R1013-182
00:07:29	1546	26	45.93360	-130.01333	Started a new DVD file.	
00:09:08	1546	26	45.93364	-130.01328	More sampling.	R1013-183
00:11:23	1546	26	45.93364	-130.01328	Interesting community composition on the lava near to Marshmallow.	R1013-184
00:12:25	1546	26	45.93364	-130.01328	Bacterial mat to the right of our sample site on Marshmallow.	R1013-185
00:12:50	1546	26	45.93364	-130.01328	Palm worms in the middle of the bacterial mat.	R1013-186
00:13:13	1546	26	45.93364	-130.01328	Some blue organism (not blue mat) in the crevice. May be a fish or worm.	R1013-187
00:13:42	1546	26	45.93364	-130.01328	Close-up of animal.	R1013-188
00:15:57	1546	26	45.93364	-130.01328	Possible iron or sulfate deposition on the lava.	R1013-189
00:16:58	1546	26	45.93364	-130.01328	We are still taking a water sample at Marshmallow.	R1013-190
00:20:04	1546	26	45.93364	-130.01328	A neat-looking tube worm.	R1013-191
00:20:20	1546	26	45.93364	-130.01328	We are finished sampling and are getting on our way.	R1013-192
00:20:57	1546	26	45.93364	-130.01328	Done fluid sampling. **Time to head to the center of the caldera to recover the acoustic release.**	
00:22:51	1546	11	45.93381	-130.01326	Apparently weak tubeworms after Ashes vent field - at Pillow.	R1013-193
00:23:26	1547	13	45.93396	-130.01324	As we left the vent field we encountered some sick looking tubeworm bushes then some pillow lavas with very iron rich sediment in the cracks.	
00:25:43	1546	29	45.93449	-130.01299	Going to take a sediment sample for Dave Clague here. Jenney is here to do that. Stopping the ship.	
00:26:46	1546	29	45.93463	-130.01289	We're here in an area of sedimented pillow/lobate flow. Lots of sediments between the pillows.	
00:27:36	1547	15	45.93467	-130.01289	We are going to take samples of the sediment without the pillows if possible.	R1013-194
00:31:54	1548	14	45.93467	-130.01288	This spot is too difficult to reach. We are changing spot.	R1013-195
00:33:19	1548	12	45.93467	-130.01288	This first location we were unable to reach the sediment.	
00:33:37	1545	18	45.93469	-130.01286	We are passing over inflated; bulbous pillows looking for another spot.	
00:34:06	1548	1	45.93473	-130.01282	This spot seems better. We try to sample here.	R1013-196
00:34:57	1548	0	45.93473	-130.01282	Suctioning the sediments for volcanic glass. Into jar#5 with a 1mm mesh size. Stopped at 00:43. z=1547m. NE of ASHES. **R1013-SS-0028 (Clague)**	
00:36:00	1548	359	45.93473	-130.01282	We are sucking it in jar 5.	R1013-197
00:37:28	1548	360	45.93479	-130.01290	The poor little brittle star in now in our sample!	R1013-198
00:42:57	1548	1	45.93480	-130.01290	We are still suctioning sediment.	R1013-199
00:44:41	1548	357	45.93480	-130.01290	We are assessing how much sediment we have collected.	R1013-200
00:45:46	1548	357	45.93480	-130.01290	Done sampling here. We will be heading to pick up the acoustic release.	
00:46:36	1548	357	45.93480	-130.01290	We are retrieving the Hobo from where we left it so we could sample.	R1013-201
00:47:47	1546	19	45.93483	-130.01290	We are heading to the Northeast to retrieve the acoustic release.	R1013-202
00:50:10	1545	13	45.93545	-130.01266	Jumbled lava enroute to the acoustic release.	R1013-203
00:53:46	1545	18	45.93624	-130.01220	Making our way to the release.	R1013-204
00:59:12	1544	44	45.93712	-130.01163	More pillow lava en route to the acoustic release.	R1013-205

Time	Z	Hdg	raw lat	raw long	R1013 Comments: ASHES (Axial)	FrGrab
01:03:57	1544	15	45.93808	-130.01136	We're transiting on the bottom to the buoy release position.	R1013-206
01:32:36	1546	13	45.94388	-130.00952	Approaching the spot where we left the release.	R1013-207
01:32:48	1546	13	45.94394	-130.00950	We are nearing the center of the caldera.	
01:36:34	1545	356	45.94473	-130.00977	Sheet flows.	
01:36:51	1546	354	45.94479	-130.00978	Sheet flows.	R1013-208
01:38:10	1545	25	45.94506	-130.00954	We have found the mooring rope.	
01:38:15	1544	21	45.94508	-130.00953	Rope in the bottom in the center of the caldera.	R1013-209
01:39:51	1545	2	45.94544	-130.00951	Rope... long rope!	R1013-210
01:43:31	1548	60	45.94609	-130.00961	There is a feeding frenzy on the barnacles that were attached to the mooring line.	
01:44:04	1548	60	45.94609	-130.00961	Crabs and barnacles around the rope of the mooring.	R1013-211
01:44:08	1548	60	45.94609	-130.00961	Putting down the hobo. Going to pick up a bunch of barnacles shells.	
01:45:03	1548	59	45.94609	-130.00961	We are sampling barnacles with the vacuum.	R1013-212
01:45:06	1548	60	45.94609	-130.00961	Suctioning barnacles from the mooring line for dissolution studies. Suction jar #6. z=1548. Caldera center. **R1013-SS-0029 (Rose)**	
01:46:41	1548	59	45.94609	-130.00961		R1013-213
01:47:34	1548	59	45.94609	-130.00961	We are sampling barnacles.	R1013-214
01:49:38	1548	59	45.94609	-130.00961	Done suction sampling. Picking up the hobo.	
01:50:57	1544	153	45.94604	-130.00960	The never-ending rope.	R1013-215
01:51:44	1546	171	45.94569	-130.00953	Sheet flow and rope.	R1013-216
01:53:57	1544	159	45.94480	-130.00941	Following the mooring line to the end.	
01:54:30	1545	164	45.94461	-130.00926	There's the release.	
01:54:46	1546	113	45.94454	-130.00927	Mooring's acoustic release.	R1013-217
01:56:15	1547	84	45.94453	-130.00925	Releasing the hook to attach the acoustic release.	R1013-218
01:58:14	1547	78	45.94453	-130.00925	Discussing how to hook the release.	
02:02:05	1546	23	45.94452	-130.00927	Picking up the hook we will attach to the release.	
02:04:02	1544	47	45.94452	-130.00921	Release is hooked and on it's way up.	
02:04:07	1540	54	45.94453	-130.00920	We have hooked the acoustic release.	R1013-219
02:06:41	1520	191	45.94474	-130.00917	Videos off. Leaving the bottom.	
03:12:39	1495	270	45.94488	-130.00912	ROPOS is at the surface. End of dive R1013.	
03:16:23	1495	270	45.94488	-130.00912	ROPOS is on deck.	

5.6.7 R1014 - SE Caldera: Coquille, Bag City, Mkr-113, International District (Axial)

R1014 SE Caldera. [R1014 Bottom time: 9/4 1622 - 9/5 0150 (9 hrs 28 min)]. No frame grabs until 1940:47 - mixup. SE caldera area exploration and sampling. Started out at Coquille vent field. HFS sampling in a tubeworm bush at a small, diffuse, unnamed vent west of Casper. Continued on to Casper for water sampling and hobo placement. Moved across the seafloor to Bag City, stopping first to suction sediments for volcaniclastic glass. Collected a pillar sample and discovered diffuse venting W of Bag City. Fluid sampling at Bag City. Discovered 2 new diffuse venting sites and tubeworms between Bag City and Mkr-113 Named the first small site "Grand Canyon", ~150m N or Bag City . The next site was dubbed "New Venting", a large area of mat, tubeworms and shimmering water ~90m S of Mkr-113. Continued on to Mkr-113 for fluid and biology sampling. Exploration in the area of Castle. Discovered several new active sulfide chimneys - the largest is > 13m tall and >330°C. Also several new (to us) diffuse vents in that area. 25 samples total. Small vent W of Casper: 4 HFS. Casper: 2 HFS, 1 gas. On the way to Bag City: 1 SS seds and 1 pillar sample. Bag City: 3 HFS. Mkr-13: 3 HFS, 2 SS of biota. El Guapo: 4 HFS, 2 gas. Diva: 1 SS blue mats and 1 bio grab. Noticed there was an offset between the MBARI SM2000 data and the navigation. The nav was putting us 20 - 30 meters west of the features we were observing in the Castle Area on the AUV map, even though it seemed to agree well for the first part of the dive (different AUV surveys)

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
15:10:00	1495	270	45.94488	-130.00912	ROPOS is in the water: 9/4 1510	
16:22:06	1535	271	45.91730	-129.99299	At the bottom. DVCAM started.	
16:22:15	1535	269	45.91730	-129.99299	ROPOS reached the bottom.	
16:27:52	1537	91	45.91726	-129.99351	Passing over older lava which have some accumulated sediment.	
16:28:31	1537	17	45.91735	-129.99336	We have entered the vent field.	
16:29:22	1537	337	45.91737	-129.99325	We have come in from the southwest and are looking for Vixen to get our bearings down here.	
16:30:13	1535	78	45.91744	-129.99320	We have just passed by a nice diffuse vent. It was straight west of Vixen.	
16:32:04	1536	120	45.91747	-129.99303	This is Casper.	
16:32:21	1537	127	45.91748	-129.99302	We are passing around **Casper**. It is very close to Vixen so it is sometimes hard to tell the two apart.	
16:34:16	1537	111	45.91748	-129.99302	There is some nice flow coming out of Casper.	
16:34:33	1537	84	45.91745	-129.99304	Heading a bit back to the west to find some diffuse vents.	
16:34:48	1536	131	45.91745	-129.99305	This is **F82**.	
16:34:54	1536	121	45.91743	-129.99305	We are passing by Vixen again. It is another mound type vent.	
16:35:56	1536	341	45.91736	-129.99291	Vixen is a little smoky.	
16:38:52	1537	125	45.91732	-129.99314	Here are some tube worms.	
16:41:42	1537	188	45.91724	-129.99299	Some nice flow coming out of this tubeworm bush. It is a slightly above average diffuse vent.	
16:43:36	1538	188	45.91724	-129.99299	This little vent does not have a name at present.	
16:43:42	1538	188	45.91724	-129.99299	We are sampling a small vent that is not named yet.	
16:43:58	1537	188	45.91724	-129.99299	We are just setting up the water sampler here.	
16:45:59	1538	188	45.91724	-129.99299	Here is a fish at the sampling site.	
16:50:23	1538	188	45.91724	-129.99299	HFS unfiltered piston #1. Tmax=28.6°C; Tavg=27°C; T2=15°C; Vol=Low; Endtime=16:53; z=1537m. Sample may not have worked. This is a small un-named diffuse vent 20m south of Vixen. **R1014-HFS-0001 (Butterfield)**	
16:54:33	1538	188	45.91724	-129.99299	HFS unfiltered piston #2. Tmax=29.5°C; Tavg=28.4°C; T2=15°C; Vol=698ml; Endtime=16:59; z=1537m. This one is working well unlike piston #1. This is a small un-named diffuse vent 20m south of Vixen. **R1014-HFS-0002 (Butterfield)**	
17:00:27	1538	188	45.91724	-129.99299	HFS Filtered bag #7. Tmax=29.7°C; Tavg=28.5°C; T2=15°C; Vol=594ml; Endtime=17:04; z=1537m. This is a small un-named diffuse vent 20m south of Vixen. **R1014-HFS-0003 (Butterfield)**	
17:06:53	1538	189	45.91724	-129.99299	HFS Sterivex filter #18. Tmax=30.7°C; Tavg=29.6°C; T2=15.5°C; Vol=2384ml; Endtime=17:24; z=1537m. This is a small un-named diffuse vent 20m south of Vixen. **R1014-HFS-0004 (Butterfield)**	
17:26:09	1535	95	45.91724	-129.99303	We are done sampling here and are heading off to Casper.	
17:26:46	1535	70	45.91735	-129.99303	We are going to sample with the HFS at Casper and then place the HOBO.	
17:28:08	1537	204	45.91748	-129.99296	This is Casper.	
17:28:17	1538	210	45.91748	-129.99296	At Casper vent. There is some good flow out of the small chimney.	
17:30:30	1538	210	45.91748	-129.99296	Casper is a very soft chimney.	
17:30:41	1538	210	45.91748	-129.99296	We are sampling Casper.	
17:32:57	1538	210	45.91748	-129.99296	Temperatures are pretty high - currently at 296°C.	
17:37:00	1538	205	45.91748	-129.99296	HFS unfiltered piston #3. Tmax=290.4°C; Tavg=289.9°C; T2=89°C; Vol=700ml; Endtime=17:41; z=1537m. Casper Vent. **R1014-HFS-0005 (Butterfield)**	
17:39:58	1538	205	45.91748	-129.99296	Gas tight bottle #11. Successful trigger. Temperature was 290°C; T2=89°C. z=1537m. Casper Vent. **R1014-gas-0006 (Evans)**	
17:43:09	1538	205	45.91748	-129.99296	Note gas tight bottle #15 on hydraulic function #4 was triggered but did not successfully fire. This was tried before gas tight bottle #15.	
17:43:30	1538	205	45.91748	-129.99296	HFS Filtered bag #9. Tmax=291.4°C; Tavg=290.8°C; T2=88°C; Vol=292ml; Endtime=17:45; z=1537m. Casper Vent. **R1014-HFS-0007 (Butterfield)**	

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
17:46:49	1538	205	45.91748	-129.99296	We are done sampling here. Next up is the HOBO.	
17:48:06	1538	205	45.91748	-129.99296	Casper is a pretty nice easy spot to sample.	
17:48:27	1538	206	45.91748	-129.99296	Here is another view of Casper.	
17:48:35	1538	206	45.91748	-129.99296	The current seems to be a bit to the south at present.	
17:49:55	1537	340	45.91735	-129.99292	At Vixen to pick up a HOBO. There is a second HOBO deployed in the vent.	
17:51:11	1538	352	45.91734	-129.99293	We have picked up the HOBO and are heading back to Casper to deploy it.	
17:55:37	1538	217	45.91748	-129.99295	We are sampling at Casper.	
17:55:40	1538	217	45.91748	-129.99295	Deploying the HOBO at Casper.	
17:59:11	1538	142	45.91748	-129.99301	The HOBO is now in place at Casper.	
18:00:53	1538	48	45.91746	-129.99306	**HOBO #103** is in Casper. Its deployment looks pretty good. It was necessary to bend it a little to keep the electronics out of the hot water.	
18:02:20	1537	77	45.91747	-129.99307	Heading to Bag City.	
18:04:13	1535	105	45.91733	-129.99256	It looks like we are already out of the hydrothermal area. The high temperature vents are on the south east border of the Coquille vent area.	
18:06:15	1534	103	45.91720	-129.99166	Mostly lobate flows with just a bit of sediment. It is an older flow.	
18:06:30	1534	103	45.91719	-129.99158	Here are driving above an isolate flow mixed with sediments.	
18:06:55	1534	104	45.91718	-129.99149	Coming over the edge of a collapse area.	
18:09:47	1533	106	45.91701	-129.99098	We can see a pillar on the right.	
18:10:41	1533	105	45.91697	-129.99082	The orange sediment we see is a sign we are approaching a hydrothermal vent region.	
18:11:41	1534	102	45.91696	-129.99067	Just past a drop off into a sheet flow. This corresponds to the map the AUV produced.	
18:12:33	1536	101	45.91696	-129.99055	This is a ropey sheet flow.	
18:12:43	1537	101	45.91696	-129.99053	We are in a ropey sheet flow. It is quite flat.	
18:16:24	1539	184	45.91688	-129.99048	This is a lava flow.	
18:16:26	1539	184	45.91688	-129.99048	We are going to stop and take a volcanic glass suction sample here.	
18:17:51	1539	184	45.91685	-129.99044	Suction sample for volcanic glass into suction Jar #5. Done at 18:26. 85m NW of Bag City on sheet flow. **R1014-SS-0008 (Clague)**	
18:18:50	1539	184	45.91685	-129.99043	This is a suction sample for volcanic glass (Jar #5).	
18:27:03	1539	231	45.91684	-129.99042	Here is a brittle star sitting on the lava flow.	
18:27:21	1539	228	45.91683	-129.99043	Finished suction sampling and are heading to Bag City.	
18:29:07	1533	198	45.91664	-129.99090	Here is some older textured rocks with lots of sponges on it.	
18:29:08	1533	195	45.91664	-129.99090	Some odd - different textured rocks. There are lots of sponges on it. It is likely some older lavas sticking through the surface.	
18:30:14	1531	129	45.91665	-129.99093	More orange sediment is being seen.	
18:31:26	1534	130	45.91643	-129.99057	Here are some lava pillars.	
18:31:38	1535	139	45.91643	-129.99054	We are now into some lava pillars.	
18:32:50	1536	120	45.91642	-129.99053	We are looking to grab a small piece of lava pillar here.	
18:33:39	1535	177	45.91643	-129.99049	Here are some lava pillars and a spider crab.	
18:37:04	1536	165	45.91640	-129.99052	Looking to grab a piece of this multi-channel pillar.	
18:39:34	1537	167	45.91640	-129.99052	Piece of pillar. We're on the older flow. Grabbing some small chunks and a big piece with a brittle star. Z=1537. On our way from Vixen to Bag City. Almost at Bag City (just west). **R1014-pillar-0009 (Chadwick)**	
18:39:41	1537	167	45.91640	-129.99052	Here is a second sample from the lava pillar.	
18:42:35	1537	167	45.91640	-129.99052	Not sure the pillar piece made it into the purse. We're going to grab another one.	
18:45:43	1537	156	45.91640	-129.99051	Here is another sample from the lava pillar.	
18:50:09	1537	158	45.91640	-129.99051	Sampling a large piece of the pillar.	
18:50:33	1537	158	45.91640	-129.99051	Large sample has a brittle star on it.	
18:52:41	1537	167	45.91640	-129.99051	Securing the sample.	
18:53:05	1537	167	45.91640	-129.99051	Moving on to Bag City. Finished sampling this pillar on the older flow.	
18:53:23	1537	166	45.91640	-129.99051	Pillar after sampling.	
18:54:19	1534	88	45.91637	-129.99033	78 meters to Bag City benchmark - plus 50 meters to the north vent - Mkr-36.	
18:54:35	1534	65	45.91643	-129.99015	Passing over a small collapse feature.	
18:54:58	1535	69	45.91650	-129.98991	Inside a larger collapse feature.	
18:56:07	1534	101	45.91664	-129.98942	Collapse feature wall.	
18:56:29	1532	97	45.91662	-129.98934	Just passed out of this collapse area to lobate flows. The AUV bathymetry tracked that beautifully.	
18:57:44	1534	247	45.91653	-129.98926	Another collapse feature.	
18:58:00	1535	66	45.91650	-129.98932	Back up on the lobate flow with intermittent collapse pits. Here comes another large collapse.	
18:58:46	1535	101	45.91664	-129.98928	No real evidence of venting in here.	
18:59:54	1534	13	45.91665	-129.98919	Edge of a collapse feature.	
19:01:07	1536	202	45.91646	-129.98950	Beautiful sting ray. He's spotted.	
19:01:37	1537	158	45.91630	-129.98955	Beautiful sting ray.	
19:02:30	1537	145	45.91626	-129.98950	Lava wall with tubeworms.	

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
19:02:34	1537	147	45.91626	-129.98949	Area of venting here. We're right near **Bag City benchmark**.	
19:03:05	1534	167	45.91623	-129.98947	We have reached the benchmark.	
19:05:27	1534	28	45.91621	-129.98937	The camera frame is here somewhere.	
19:05:33	1533	45	45.91621	-129.98937	On top of the lava wall.	
19:05:56	1534	127	45.91626	-129.98938	Tubeworms at **Bag City Vent field**.	
19:06:22	1533	66	45.91624	-129.98929	Mkr 36 at Bag City.	
19:06:29	1534	60	45.91625	-129.98927	Getting DSCs here.	
19:06:56	1534	114	45.91630	-129.98927	Getting some images of this area. There's Mkr-36 here and the camera frame. Tubeworm bushes are thick here.	
19:08:37	1536	216	45.91631	-129.98916	Close-up of the tubeworm patch we are going to sample.	
19:10:43	1536	218	45.91631	-129.98917	Preparing to sample here in this healthy looking tubeworm bush at Bag City near Mkr-36.	
19:11:23	1536	219	45.91631	-129.98917	Measuring the temperature - looking for a good spot to sample.	
19:11:36	1536	219	45.91631	-129.98917	Trying to decide what samples to take right now.	
19:14:56	1536	216	45.91630	-129.98917	Poking around in this healthy tubeworm bush trying to find the best place to sample.	
19:15:50	1536	216	45.91630	-129.98917	Dropped the nozzle - but the temp is going up. hmmm	
19:17:29	1536	216	45.91630	-129.98917	Close-up with white bacterial filaments on tubeworms.	
19:17:53	1536	216	45.91630	-129.98917	Going to leave the probe where it fell. The temps looks good.	
19:18:41	1536	216	45.91631	-129.98917	We were only seeing 14° there and Dave thinks we should be able to get better temps than that. Going to pick it up and poke around.	
19:19:40	1536	216	45.91631	-129.98917	Picked up the probe.	
19:22:04	1536	216	45.91631	-129.98917	The temp is good here. Stable at ~15°C. Moving the valve.	
19:22:31	1536	216	45.91631	-129.98917	Measuring the temperature - stable at about 15 deg-C.	
19:22:49	1536	216	45.91631	-129.98917	HFS unfiltered bag #12. Tmax=15.1°C; Tavg=14.7°C; T2=~12°C; Vol=580ml; Starttime=1930:45 Endtime=1934:20. z=1536m. In healthy tubeworm bush at Bag City (Mkr-36). **R1014-HFS-0010 (Butterfield)**	
19:24:22	1536	216	45.91631	-129.98917	Close-up of the tubeworms.	
19:25:09	1536	216	45.91631	-129.98917	Another close-up of the tubeworm patch.	
19:26:11	1536	216	45.91631	-129.98917	Pink bacterial mat (?)	
19:31:29	1536	216	45.91631	-129.98917	Close-up of the tubeworm plumes.	
19:31:39	1536	216	45.91631	-129.98917	The tubeworms.	
19:31:43	1536	216	45.91631	-129.98917	The tubeworms.	
19:35:38	1536	216	45.91631	-129.98917	Close-up of tubeworms with bacteria.	
19:35:46	1536	216	45.91631	-129.98917	HFS filtered bag #8. Tmax=15.2°C; Tavg=14.7°C; T2=12°C; Vol=590ml; Endtime=1939:25; z=1536m. In healthy tubeworm bush at Bag City (Mkr-36). **R1014-HFS-0011 (Butterfield)**	
19:37:39	1536	216	45.91630	-129.98917	The head of a tubeworm tucked inside its tube.	
19:37:45	1536	216	45.91630	-129.98917	The same tubeworm peaking out.	
19:40:47	1536	216	45.91630	-129.98917	**FROM THIS POINT ON THE FRAME GRABS AGREE WITH THE LOG ENTRIES. NEARLY ALL GRABS BEFORE THIS TIME WERE LOST. 2 FRAME GRAB WINDOWS WERE OPEN AND ALL PREVIOUS GRABS WERE OVERWRITTEN...**. There is a little bacterial mat on the left rear tubeworm.	R1014-055
19:41:00	1536	216	45.91630	-129.98917	HFS sterivex filter #15. Tmax=15.5°C; Tavg=14.9°C; T2=12°C; Vol=3010ml; Endtime=2005:00; z=1536m. Bag City (Mkr-16 area). **R1014-HFS-0012 (Butterfield)**	
19:44:18	1536	216	45.91630	-129.98917	Palm worms in the center.	R1014-056
19:44:26	1536	216	45.91630	-129.98917	Palm worms.	R1014-057
19:45:24	1536	216	45.91630	-129.98917	Palm worm close-up. Limpet necklaces.	R1014-058
19:53:15	1536	217	45.91630	-129.98918	Nozzle position.	R1014-059
20:05:50	1536	216	45.91630	-129.98917	We're done sampling here.	
20:06:10	1536	216	45.91630	-129.98917	We're removing the nozzle from the tubeworm bush. We will head to Marker 113 next.	
20:08:10	1533	8	45.91642	-129.98925	We're outta here. Leaving Bag City and heading north to Mkr-113. 666m at a bearing of 6°. We're traveling over the bottom along the pre-87 lava flow. Will go over a big drain out network.	
20:09:45	1534	347	45.91689	-129.98968	Edge of a collapse pit.	R1014-060
20:10:10	1534	18	45.91713	-129.98975	We're leaving the uncollapsed part and going over this lineated flow on the drain-out channel. Big flat expanse here. The MBARI map seems to be very well registered today.	
20:10:26	1537	19	45.91723	-129.98971	Lineated sheet flow.	R1014-061
20:11:00	1536	18	45.91732	-129.98967	At the northern edge of this flat channel. There's a small island in the bathymetry. This is it.	
20:11:02	1536	19	45.91733	-129.98966	Northern edge of flat channel - facing a lava wall.	R1014-062
20:11:37	1534	254	45.91744	-129.98959	This lava island shows up in the MBARI data.	R1014-063

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
20:11:58	1533	356	45.91742	-129.98961	Going to drive to the east about 30 m. Going to take a look at a thin deep channel or a fissure.	
20:12:42	1537	103	45.91739	-129.98948	Traveling over ropey lavas.	
20:13:13	1537	114	45.91735	-129.98931	Bottom has dropped out on us.	R1014-064
20:13:16	1538	110	45.91734	-129.98930	The bottom is dropping out on us. We're in the fissure here. Big wall to the west. A bit of a drain out feature on the wall.	
20:13:38	1538	23	45.91731	-129.98921	Side of channel.	R1014-065
20:13:55	1537	346	45.91732	-129.98915	Drain out structure.	R1014-066
20:14:46	1537	324	45.91741	-129.98910	Getting some images of the west wall of this. Looks like a younger flow at the top.	
20:15:04	1534	351	45.91742	-129.98910	Top edge of channel.	R1014-067
20:15:15	1534	356	45.91744	-129.98910	Channel wall.	R1014-068
20:15:33	1534	332	45.91748	-129.98907		R1014-069
20:15:52	1535	14	45.91753	-129.98907	All the walls are coated with drain out and in places you can see lobes flowing in over the wall.	
20:16:12	1536	24	45.91762	-129.98898	Large pillows flowing into the channel.	R1014-070
20:16:30	1535	7	45.91768	-129.98891	Bathtub rings on the wall.	R1014-071
20:16:49	1535	324	45.91774	-129.98883	We're coming out of the narrow part of the channel and its opening up into a larger collapse area.	
20:17:05	1534	325	45.91781	-129.98883	Coming out of the narrow part of the channel.	R1014-072
20:17:28	1532	212	45.91790	-129.98886	The channel was a least 3 meters deep - probably deeper. Seeing hydrothermal seds but they don't look active.	
20:18:05	1534	19	45.91793	-129.98895	Looks like an area of venting here.	
20:18:06	1534	17	45.91793	-129.98895	Found some hydrothermal flow.	R1014-073
20:18:26	1537	6	45.91801	-129.98893	Adding a target here. Calling it Grand Canyon. Nice tubeworm bush and lots of chemosynthetic clams here.	
20:18:32	1537	6	45.91800	-129.98893	Tubeworm patch with hydrothermal flow. Called this Grand Canyon. Patches of tubeworms and chemosynthetic clams.	R1014-074
20:19:13	1537	34	45.91814	-129.98886	Clams on the basalt.	R1014-075
20:19:36	1537	24	45.91821	-129.98877	Fractures	R1014-076
20:19:37	1537	21	45.91821	-129.98876	Little patches of blue mat here too.	
20:19:58	1536	335	45.91835	-129.98874	In the middle of a collapse feature.	R1014-077
20:20:21	1537	8	45.91839	-129.98876	Venting lines on tall pillars.	R1014-078
20:20:47	1535	50	45.91846	-129.98880	Mat on this lava arch.	
20:20:56	1534	50	45.91845	-129.98880	Close-up of the lava pillar with some hydrothermal mat.	R1014-079
20:21:22	1532	4	45.91852	-129.98873	Broken up jumbled flow in this collapse channel system. Will get to the head of the channel soon. The bottom is flat and lineated here.	
20:21:42	1535	6	45.91864	-129.98873	Flat lineated flow.	R1014-080
20:22:02	1535	4	45.91879	-129.98874	Joystick vent is off to the east a little bit.	
20:22:16	1535	2	45.91888	-129.98875	Pillars.	R1014-081
20:22:24	1534	14	45.91891	-129.98877	We're going north. Forest of pillars here. We're moving FAST.	
20:22:40	1533	3	45.91895	-129.98877	More pillars.	R1014-082
20:23:18	1533	35	45.91910	-129.98864	Crossing over a jumbled up chaotic section of lava now.	
20:23:42	1536	32	45.91917	-129.98857	Passing over a pressure ridge. Looks like a long tube.	
20:23:43	1536	35	45.91918	-129.98857	Pressure ridge.	R1014-083
20:24:44	1535	8	45.91931	-129.98853	Pillar.	R1014-084
20:24:46	1535	8	45.91931	-129.98853	Pillars in this collapse area. Should be getting into a narrow area.	
20:25:04	1535	2	45.91938	-129.98856	Thin pillar.	R1014-085
20:25:23	1535	339	45.91942	-129.98855	Top of thin pillar.	R1014-086
20:25:24	1535	338	45.91942	-129.98855	DSC of this lonely pillar.	
20:25:36	1535	10	45.91942	-129.98857	The channel edges are overhung here. Beautiful lava pillars and large arch features. Some lobate flows in the middle of this channel. Probably flowed in from the north because the channel gets less deep to the north.	
20:25:39	1535	27	45.91943	-129.98858	Edge of the channel.	R1014-087
20:26:03	1535	346	45.91946	-129.98856	Lobate flows in the middle of the channel.	R1014-088
20:26:22	1533	4	45.91951	-129.98859	More pillars.	R1014-089
20:26:37	1534	350	45.91954	-129.98859	Pillar close-up.	R1014-090
20:27:23	1533	11	45.91956	-129.98861	Taking a few DSCs here in the area of these pillars.	
20:27:41	1534	1	45.91957	-129.98862	More of the pillars.	R1014-091
20:28:00	1533	8	45.91966	-129.98862	Collapse channels.	R1014-092
20:28:14	1532	7	45.91975	-129.98860	We're at the end of the channel. We should be on intact flows for most the rest of the way to Mkr-113. The map is right on.	
20:28:18	1532	7	45.91979	-129.98860	Traveling down the end of the channel - where it splits in two.	R1014-093
20:29:18	1530	354	45.92007	-129.98871	Hydrothermal sediment in between the lobes.	R1014-094
20:29:46	1529	1	45.92020	-129.98875	Lots of hydrothermal sediment between the lobes and pillows here. Not active - yellow/orange tinge to it which usually means it's old.	R1014-095

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
20:31:49	1528	21	45.92063	-129.98868	Not as much old brown hydrothermal deposits. The lava flow is much fresher and glassier here.	
20:31:57	1528	23	45.92066	-129.98866	Lobate flows.	R1014-096
20:32:42	1529	22	45.92080	-129.98856	Bill says this is not the 1998 flow (he doesn't think). We're unsure of the boundary up here.	
20:34:09	1528	5	45.92107	-129.98845	Huge rat tail fish.	R1014-097
20:37:06	1523	13	45.92162	-129.98840	Signs of venting.	R1014-098
20:37:15	1523	13	45.92166	-129.98839	More hydrothermal activity here. We see chemosynthetic clams.	
20:38:02	1525	20	45.92169	-129.98840	Close-up of areas of venting.	R1014-099
20:38:45	1526	23	45.92171	-129.98838	Limpets and clams. They're alive. Little bit of mat here. Don't see any shimmering.	
20:38:49	1526	23	45.92171	-129.98838	Clams and limpets.	R1014-100
20:39:55	1524	336	45.92175	-129.98838	Hydrothermal outcrops.	R1014-101
20:39:59	1524	341	45.92174	-129.98840	There's a large area of mat and tubeworms here and shimmering water. We're 100 m south of Mkr-113.	
20:40:45	1526	38	45.92189	-129.98853	Overview of this large area of diffuse hydrothermal venting.	R1014-102
20:41:07	1526	30	45.92192	-129.98849	Tubeworm patch with noticeable flow.	R1014-103
20:42:04	1524	12	45.92206	-129.98835	Lots of warm water coming out.	
20:42:41	1525	33	45.92215	-129.98830	Close-up of diffuse flow.	R1014-104
20:43:21	1525	16	45.92232	-129.98821	We're on the outskirts of the extensive collapse area where Mkr-113 lives.	
20:43:57	1522	9	45.92251	-129.98820	Mkr-113 is on a raised area surrounded by collapse.	
20:44:17	1524	290	45.92251	-129.98826	Looking into a collapse pit.	R1014-105
20:44:34	1524	276	45.92247	-129.98832		
20:44:43	1524	346	45.92247	-129.98840	There is diffuse venting all over the place here.	
20:45:02	1525	357	45.92256	-129.98840	Collapse wall.	R1014-106
20:45:15	1524	6	45.92261	-129.98843	More shimmer here. This looks like it. There's a marker here. We're at Mkr-113.	
20:45:45	1525	15	45.92271	-129.98840	Approaching a large tubeworm patch at **Mkr 113**.	R1014-107
20:46:23	1525	17	45.92273	-129.98839	Close-up of the tubeworm patch.	R1014-108
20:46:28	1525	21	45.92274	-129.98838	Looking at this beautiful venting area on top of a lava ledge. Lush tubeworm bushes.	
20:47:10	1524	71	45.92278	-129.98843	Top of the collapse wall.	R1014-109
20:47:38	1523	79	45.92280	-129.98844	Looking for limpets to suction. They're everywhere.	
20:48:11	1525	106	45.92282	-129.98841	There are "many" limpets at this site. There are blue mats here too. Tons of tubeworms. Very lush here.	
20:48:16	1525	104	45.92282	-129.98842	Preparing to sample limpets.	R1014-110
20:48:57	1525	97	45.92282	-129.98841	Will suction into jar #1 (180 micron mesh).	
20:49:23	1525	97	45.92282	-129.98841	Flushing into jar #8 first.	
20:50:31	1525	97	45.92282	-129.98841	Suctioning limpets.	R1014-111
20:50:45	1525	97	45.92282	-129.98841	There is an anemone is the area too.	
20:51:09	1525	97	45.92282	-129.98841	Suction limpets and other biota into jar #1 (180 micron mesh). Endtime=2054. This are is lush and jam packed with biota. Z=1525. Mkr-113 area. **R1014-SS-0013 (Rose)**	
20:51:11	1525	97	45.92282	-129.98841	Suctioning limpets.	R1014-112
20:53:46	1525	96	45.92282	-129.98841	Suction jar 1 with limpets.	R1014-113
20:56:31	1525	102	45.92282	-129.98841	Suction limpets; snails; pycnogonids; possibly a clam or two and other biota into jar #2. This is a broad sample. Start time=2058:50 End time=2108. Z=1524.5 Mkr-113 area. **R1014-SS-0014 (Rose)**	
20:57:31	1525	112	45.92282	-129.98841	Clams.	R1014-114
20:57:58	1525	112	45.92282	-129.98841	Lots of provanid snails in the area of the chemosynthetic clams.	
20:59:05	1525	112	45.92282	-129.98841	Getting a second suction sample.	R1014-115
21:03:55	1525	112	45.92283	-129.98841	Jar 2 after sampling.	R1014-116
21:05:57	1525	112	45.92282	-129.98841	Continuing to sample into jar 2.	R1014-117
21:08:39	1525	112	45.92282	-129.98841	Done sampling.	R1014-118
21:09:26	1525	112	45.92282	-129.98841	Done with biology sampling here. Jonathan get quite a nice mixed sample here.	
21:10:49	1525	112	45.92283	-129.98841	This MTR was deployed in 2001.	
21:11:59	1525	189	45.92285	-129.98836	We think this is a MTR.	R1014-119
21:12:19	1525	189	45.92285	-129.98836	The monkey fist is covered with limpets.	
21:12:41	1525	189	45.92285	-129.98836	Recovering the MTR.	R1014-120
21:12:45	1524	189	45.92285	-129.98836	We recovered a MTR that has been here for many many years.	
21:13:54	1524	189	45.92285	-129.98836	**RECOVERED MTR #1055** from Mkr-113. Deployed in 2001.	
21:14:17	1525	189	45.92285	-129.98836	MTR #1055 recovery.	R1014-121
21:16:17	1524	189	45.92285	-129.98836	The float broke off.	
21:19:23	1524	189	45.92285	-129.98836	The MTR is in the purse. Along with a large piece of pillar.	
21:20:50	1525	189	45.92285	-129.98836	We're going to do some fluid sampling now.	
21:22:35	1524	189	45.92285	-129.98836	Mkr-113 possible fluid sampling site.	R1014-122

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
21:22:37	1524	189	45.92285	-129.98836	Poking around for a good place to sample water.	
21:24:33	1525	32	45.92279	-129.98838	Positioning the wand.	
21:24:57	1525	32	45.92279	-129.98838	Mkr-113 possible fluid sampling site.	R1014-123
21:26:21	1525	32	45.92279	-129.98838	Moving DSCs now.	
21:28:15	1524	32	45.92279	-129.98838	Mkr-113 fluid sample preparation.	R1014-124
21:31:56	1524	32	45.92276	-129.98841	We're messing around trying to get the fluid sampler ready.	
21:32:14	1524	32	45.92276	-129.98841	HFS filtered bag #10. Tmax=28.7°C; Tavg=285.2°C; T2=18°C; Vol=597ml; Endtime=2136; z=1524m. Lush biota area. In a tubeworm bush. Mkr-113 area. **R1014-HFS-0015 (Butterfield)**	
21:34:02	1524	32	45.92274	-129.98842	Big flock storm going on around here. ROPOS swears they didn't do it. Is it a mermaid?	
21:35:21	1524	32	45.92274	-129.98843	Mkr-113 fluid sampling filtered bag #10.	R1014-125
21:38:44	1524	31	45.92274	-129.98844	HFS unfiltered bag #14. Tmax=28.5°C; Tavg=28.3°C; T2=18°C; Vol=602ml; Endtime=2142; z=1524m. Same spot as previous sample. In tubeworm bush. Mkr-113 area. **R1014-HFS-0016 (Butterfield)**	
21:38:46	1524	31	45.92274	-129.98844	Mkr-113 fluid sampling unfiltered bag #14.	R1014-126
21:41:15	1524	31	45.92274	-129.98844		R1014-127
21:42:56	1524	31	45.92273	-129.98845	Mkr-113 tube worms.	R1014-128
21:43:15	1524	31	45.92273	-129.98845	Mkr-113 tube worms.	R1014-129
21:43:37	1524	31	45.92272	-129.98845	HFS sterivex filter #20. Tmax=28.5°C; Tavg=27.5°C; T2=17°C; Vol=2208ml; Endtime=2159:30; z=1524m. In the tubeworm bush. Mkr-113 area. **R1014-HFS-0017 (Butterfield)**	
21:45:23	1524	31	45.92273	-129.98846	Mkr-113 palm worms.	R1014-130
21:47:56	1524	31	45.92272	-129.98846	Mkr-113 liquid acid test.	R1014-131
21:49:25	1524	31	45.92272	-129.98847	Mkr-113 hydro fluid sampling Sterivex #20.	R1014-132
21:50:14	1524	31	45.92272	-129.98847	Mkr-113 sample area overview.	R1014-133
21:50:59	1524	31	45.92273	-129.98847	Mkr-113 diffusive venting.	R1014-134
21:52:15	1524	31	45.92273	-129.98847	Mkr-113 clams.	R1014-135
21:52:48	1525	31	45.92273	-129.98847	Mkr-113 Clams.	R1014-136
21:58:40	1524	31	45.92274	-129.98846	Mkr-113 palm worms.	R1014-137
22:00:22	1524	31	45.92272	-129.98848	Mkr-113 fluid sample site end.	R1014-138
22:01:28	1524	31	45.92272	-129.98849	Our next target is Castle.	
22:02:34	1523	54	45.92271	-129.98848	Leaving Mkr-113.	R1014-139
22:02:38	1522	63	45.92272	-129.98847	Leaving the site. Lots of floc underneath us. We're looking at the bottom of the collapse. Lots of venting underneath. It's trapped under the roof.	
22:03:11	1525	355	45.92270	-129.98841	Looking at the ledge before leaving Mkr-113.	R1014-140
22:03:13	1526	355	45.92270	-129.98841	Leaving Mkr-113.	R1014-141
22:03:41	1527	10	45.92271	-129.98842	Under the lava ledge as we're leaving Mkr-113.	R1014-142
22:04:00	1527	12	45.92271	-129.98842	Mkr-113 microbial mat on the underside of the ledge.	R1014-143
22:05:13	1525	45	45.92272	-129.98843	Taking a bunch of DSCs and frame grabs as we leave this area.	
22:05:56	1523	55	45.92278	-129.98831	Sea floor traveling towards Castle.	R1014-144
22:07:43	1525	39	45.92304	-129.98790	We're moving toward Castle and going to try not to stop.	
22:07:58	1525	38	45.92310	-129.98783	Jumble collapse lava on the way to castle.	R1014-145
22:09:03	1523	68	45.92326	-129.98760	We're up on the lobate portion of the flow.	
22:09:12	1522	67	45.92327	-129.98755	Lobate traveling towards Castle.	R1014-146
22:09:49	1523	67	45.92333	-129.98735	Lots of sponges and orange staining on these pillows.	
22:09:51	1523	66	45.92333	-129.98734	Sponges and orange staining while traveling to Castle.	R1014-147
22:10:12	1522	66	45.92336	-129.98725	Coming over the collapse area.	
22:11:17	1522	70	45.92343	-129.98697	Edge of collapse.	R1014-148
22:11:35	1522	69	45.92345	-129.98688	Dropping down over the edge of this lobate flow into a collapse area of pillars.	
22:13:15	1521	66	45.92357	-129.98643	Passing over this area of lobate lavas.	
22:13:38	1522	65	45.92361	-129.98629	Lobates.	R1014-149
22:20:42	1523	46	45.92437	-129.98494	Hydrothermal sediment.	R1014-150
22:21:07	1521	47	45.92444	-129.98482	We're traveling toward Castle now.	
22:22:55	1524	47	45.92466	-129.98448	Ropey-sheet flow.	R1014-151
22:24:33	1525	65	45.92481	-129.98397	Ropey jumbled lavas on this collapse area.	R1014-152
22:30:10	1527	75	45.92535	-129.98267	Traveling over jumbled collapse to ropey lavas.	
22:30:10	1527	75	45.92535	-129.98267	Big ole jumbled mess o' lava.	R1014-153
22:32:25	1521	65	45.92544	-129.98202	We just crossed the deepest axis of 1998 lava - it was filled with jumbled lavas.	
22:32:51	1522	63	45.92547	-129.98193	We're in a little section of flat lineated sheet flow here.	
22:32:59	1523	63	45.92548	-129.98192	Flat lineated sheet flows.	R1014-154
22:34:36	1523	61	45.92561	-129.98160	Popping up on top of the lobates here.	R1014-155
22:34:59	1520	59	45.92565	-129.98150	Going over more lobates now.	
22:35:33	1520	58	45.92571	-129.98138	Little "Swiss cheese" part of the 1998 flow.	
22:35:38	1520	58	45.92572	-129.98137	Swish cheese part of 1998 flow.	R1014-156
22:36:06	1520	57	45.92578	-129.98124	"Swiss cheese" is half collapse and half not. It's a Bill term.	

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
22:36:56	1521	56	45.92588	-129.98104	Collapse Edge.	R1014-157
22:37:11	1521	56	45.92591	-129.98098	Collapse Edge.	R1014-158
22:37:36	1521	55	45.92595	-129.98093		
22:38:08	1521	54	45.92601	-129.98082	More collapse edge.	R1014-159
22:38:47	1519	77	45.92610	-129.98066	Fish off 1998 flow.	R1014-160
22:38:57	1518	80	45.92610	-129.98061	We're off the 1998 flow. We're on older pillow lavas.	
22:39:18	1517	77	45.92611	-129.98052	We went over a pillow hill. Back on the 1998 lava. Venting up ahead. Getting close to Castle.	
22:40:01	1518	10	45.92615	-129.98037	We're at Castle.	
22:40:02	1518	11	45.92615	-129.98038	**Castle.**	R1014-161
22:40:40	1517	53	45.92620	-129.98044	Castle	R1014-162
22:40:47	1517	51	45.92621	-129.98042	Missed 1 minute of DVCam data.	
22:40:55	1517	54	45.92622	-129.98042	Castle	R1014-163
22:41:18	1515	54	45.92622	-129.98042	Castle	R1014-164
22:41:33	1514	5	45.92620	-129.98037	We're at Castle. The top of the Chimney is covered in filamentous bacteria.	
22:41:47	1514	351	45.92620	-129.98034	Arrived at Castle	R1014-165
22:42:16	1513	304	45.92624	-129.98031	Castle.	R1014-166
22:42:43	1517	344	45.92619	-129.98035	Castle.	R1014-167
22:43:43	1515	359	45.92618	-129.98038	There are several chimneys in this area. There is Castle - one nearby (Mkr N5) and a 3rd one in the neighborhood.	
22:45:11	1517	357	45.92617	-129.98038	We're looking at the sonar to try to figure out what's in the area. The chimney to the east is about 20 m away.	
22:45:20	1516	1	45.92616	-129.98038	This is the tower of Castle.	R1014-168
22:45:40	1514	163	45.92620	-129.98041	Facing south now to look around. Don't really see anything to the south.	
22:48:23	1511	245	45.92612	-129.98049	Transferring files.	
22:48:58	1517	8	45.92612	-129.98053	Castle. Sonar target 20 m east/southeast probably Flattop. Topgun is 55 m to the northeast. The distances are all guesses.	
22:50:41	1515	130	45.92609	-129.98023	Pile of pillow basalts.	
22:50:43	1515	130	45.92609	-129.98023	Nice rock formation on the way to the other chimneys in Castle.	R1014-169
22:51:23	1517	51	45.92612	-129.98022	There is another chimney here. This is **Flat Top**.	
22:51:31	1517	73	45.92615	-129.98023	This is Flat Top.	R1014-170
22:52:47	1517	1	45.92614	-129.98028	Passing Castle again and turning east back to Flat Top.	
22:53:05	1517	107	45.92619	-129.98025	This is still Flat Top.	R1014-171
22:53:53	1512	33	45.92614	-129.98013	Isn't flat?	R1014-172
22:53:58	1511	32	45.92615	-129.98013	The depth at the top of Flat Top is 1511 meters.	
22:56:37	1519	22	45.92614	-129.97998	Want to head at 020 from Flat Top to look for the other potential chimney.	
22:56:39	1520	29	45.92616	-129.97997	Rocks after leaving Flat top.	R1014-173
22:57:43	1519	86	45.92633	-129.97985	We have found an **old dead sulfide chimney about 2 meters tall.**	
22:58:28	1521	17	45.92645	-129.97979	**Probably Top Gun.**	R1014-174
22:58:37	1522	7	45.92646	-129.97978	There is another large chimney here. This one may be dead as well.	
22:58:53	1520	12	45.92647	-129.97978	Top Gun chimney.	R1014-175
22:59:13	1517	15	45.92648	-129.97978	Top Gun and company.	R1014-176
22:59:25	1516	38	45.92648	-129.97979	This is a large complex of chimneys. There is one that is definitely active. It is covered with bacterial mat and a large tubeworm bush. It is about 9 meters tall.	
22:59:53	1517	10	45.92649	-129.97969	Top of the chimney	R1014-177
23:00:28	1518	358	45.92650	-129.97966	9 meter tall chimney.	R1014-178
23:00:52	1518	355	45.92651	-129.97965	There is some blue mat on the top as well.	
23:01:09	1518	357	45.92651	-129.97965		R1014-179
23:02:22	1518	33	45.92651	-129.97969	View of the **9 meter active chimney.**	R1014-180
23:03:33	1517	345	45.92652	-129.97984		R1014-181
23:03:33	1517	345	45.92652	-129.97984	Another large chimney just north of the active one we just saw. It is active at the top and about **13 meters tall. This is a smoker. It has been dubbed El Guapo**. Comes to a point at the top with many black smoking beehives.	
23:03:59	1512	15	45.92654	-129.97988	El Guapo.	R1014-182
23:04:09	1510	13	45.92655	-129.97987	El Guapo - toward the top.	R1014-183
23:04:38	1508	34	45.92656	-129.97989	The top of El Guapo.	R1014-184
23:05:29	1508	42	45.92656	-129.97990	ElGuapo Chimney	R1014-185
23:05:45	1508	42	45.92657	-129.97990	El Guapo - moving down slightly.	R1014-186
23:06:06	1509	35	45.92656	-129.97989	El Guapo	R1014-187
23:08:04	1508	40	45.92657	-129.97989	The Top of El Guapo	R1014-188
23:08:14	1509	40	45.92658	-129.97989	The second time around the top again of El Guapo.	R1014-189
23:09:20	1510	37	45.92657	-129.97989	Taking some DSCs up and down **El Guapo. This is the tallest chimney we have seen at Axial.**	
23:09:29	1511	38	45.92657	-129.97989	Walls of El Guapo.	R1014-190
23:09:37	1511	34	45.92657	-129.97989	The sides of El Guapo.	R1014-191
23:11:42	1508	34	45.92655	-129.97991	Top of El Guapo.	R1014-192

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
23:12:03	1508	315	45.92657	-129.97982		R1014-193
23:12:14	1508	274	45.92660	-129.97980	Beehive black smokers at the top of El Guapo.	R1014-194
23:12:29	1509	230	45.92663	-129.97982		R1014-195
23:12:41	1509	227	45.92663	-129.97983	Moving down El Guapo.	R1014-196
23:13:24	1509	344	45.92656	-129.97985		R1014-197
23:15:54	1510	56	45.92658	-129.97991		R1014-198
23:16:56	1509	81	45.92660	-129.97991	Still the top of El Guapo.	R1014-199
23:17:55	1509	90	45.92660	-129.97991		R1014-200
23:21:30	1508	81	45.92659	-129.97992	Trying to find a place to grab on with the arm to stabilize enough to take a sample.	
23:22:51	1509	77	45.92660	-129.97991	We are trying to stabilize the ROPOS.	R1014-201
23:24:25	1509	50	45.92658	-129.97992		R1014-202
23:27:28	1509	81	45.92660	-129.97991	We released the chimney newly called El Guapo for a better spot.	R1014-203
23:27:44	1509	83	45.92660	-129.97991	Having trouble getting a good grip. The chimney is very friable.	
23:29:29	1509	127	45.92662	-129.97990	Looks like we have a good grip and are getting ready to take a fluid sample.	
23:30:40	1509	125	45.92662	-129.97990	We are trying a temperature measurement on the top.	R1014-204
23:31:16	1509	121	45.92662	-129.97991	Checking the temperature of El Guapo.	
23:31:51	1509	122	45.92662	-129.97990	Taking the temp at the top of El Guapo.	R1014-205
23:32:18	1509	122	45.92662	-129.97990	Highlights off.	
23:33:15	1509	119	45.92662	-129.97991	**Max temperature at El Guapo was 298.6**. We are seeing bubbles coming out in the flow too.	
23:33:33	1509	119	45.92662	-129.97991	HFS filtered bag #11. Tmax=298.6°C; Tavg=285°C; T2=°C; Vol=329ml; Endtime=23:37; z=1509m. El Guapo. **R1014-HFS-0018 (Butterfield)**	
23:33:51	1509	120	45.92662	-129.97991		R1014-206
23:35:40	1509	119	45.92662	-129.97991	Gas tight bottle #7 - hydraulic line #1. Fired successfully. Z=1509 m. El Guapo. **R1014-gas-0019 (Evans)**	
23:36:24	1509	119	45.92662	-129.97991	HFS unfiltered bag #13. Tmax=313.4°C; Tavg=307.4°C; T2=70°C; Vol=317ml; Endtime=23:40; z=1509m. El Guapo. **R1014-HFS-0020 (Butterfield)**	
23:37:56	1509	119	45.92662	-129.97991	Gas tight bottle #2 - hydraulic line #2. Fired successfully. Z=1409 m. El Guapo. **R1014-gas-0021 (Evans)**	
23:38:30	1509	119	45.92662	-129.97991	High of 317 degrees so far.	
23:39:31	1509	119	45.92662	-129.97991	HFS filtered piston #6. Tmax=336.5°C; Tavg=319.2°C; T2=70°C; Vol=619ml; Endtime=23:45; z=1509m. El Guapo. **R1014-HFS-0022 (Butterfield)**	
23:41:51	1509	119	45.92662	-129.97991	Temperature is still creeping up. It is up to 320 degrees now.	
23:42:32	1509	119	45.92662	-129.97991	Highlights are back on.	
23:43:23	1509	119	45.92662	-129.97991	The tip of the fluid sampler is getting insulated and is allowing the temperature to keep rising. It is holding at about **337 degrees now.**	
23:46:23	1509	120	45.92662	-129.97991	It looks like this vent is boiling.	
23:46:27	1509	120	45.92662	-129.97991	HFS filtered piston #5. Tmax=338.7°C; Tavg=337.6°C; T2=73°C; Vol=567ml; Endtime=23:46; z=1509m. El Guapo. **R1014-HFS-0023 (Butterfield)**	
23:50:09	1509	120	45.92662	-129.97991	The tip of the fluid sampler in El Guapo chimney.	R1014-207
23:52:45	1509	121	45.92662	-129.97991	Going to move the temp probe around to see if we find a higher temperature. Boiling at this depth should be around 348 degrees.	
23:57:41	1509	120	45.92662	-129.97991	Moving the HFS probe around to a new spot. So far we haven't seen higher than 338 degrees.	
23:58:47	1509	120	45.92662	-129.97991	Knocked over a small spire on the side of El Guapo. We will check the temperature in that new orifice.	
00:03:45	1509	156	45.92663	-129.97989	We are trying to grab again the chimney.	R1014-208
00:03:45	1509	156	45.92663	-129.97989	Done probing for temperature.	
00:06:00	1509	358	45.92656	-129.97986		R1014-209
00:06:18	1511	29	45.92657	-129.97989	The basis of El Guapo.	R1014-210
00:08:13	1513	201	45.92660	-129.98000	Flat top?...	R1014-211
00:09:33	1515	75	45.92658	-129.98002	We left El Guapo and headed southwest and found another flat topped chimney. There is another dead chimney just northwest of El Guapo with some white staining at the base.	
00:11:16	1515	271	45.92657	-129.97995	Flat top too or two... southwest of El Guapo.	R1014-212
00:12:31	1515	325	45.92652	-129.97997		R1014-213
00:13:39	1516	39	45.92650	-129.98000	Back in the dead chimney field but they are not sure if this is Top Gun or not.	
00:13:57	1516	61	45.92658	-129.97992	Base of who?	R1014-214
00:14:38	1515	68	45.92654	-129.97981	Starting a new DVD volume.	
00:15:04	1519	66	45.92654	-129.97973	We are back at the 9 meter chimney.	
00:15:06	1519	61	45.92654	-129.97973	The new chimney on the east.	R1014-215
00:16:31	1524	79	45.92652	-129.97962	Passing over an area of diffuse venting and coming up to another chimney. There is more smoke off in the distance to the east.	
00:16:46	1522	124	45.92650	-129.97959	Blue mats on this chimney on the east.	R1014-216
00:17:44	1519	66	45.92641	-129.97958	There is another small anhydrite chimney here. This one has a lot of blue mat on the periphery. Dave is drawing a map of all these chimneys.	

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
00:18:18	1522	50	45.92643	-129.97944	Blue mats surrounding an anhydrite formation. **This vent was later named "Diva".**	R1014-217
00:19:39	1525	198	45.92643	-129.97943	This area may be bigger than the ASHES field.	
00:19:42	1525	175	45.92642	-129.97945		R1014-218
00:21:08	1524	141	45.92650	-129.97942	We may have one sample around this site.	R1014-219
00:21:19	1524	140	45.92650	-129.97942	Settling down at this small anhydrite chimney to have a look and possibly do some sampling.	
00:21:25	1524	140	45.92650	-129.97942		R1014-220
00:24:38	1524	140	45.92650	-129.97942	Going to take a little tour around this anhydrite mound and take DSCs of the blue mats. This is now called Diva!	
00:24:44	1524	140	45.92650	-129.97942	We are going to take some DSCs around Diva for Angela's blue mats.	R1014-221
00:29:05	1524	304	45.92645	-129.97934	Diva the anhydrite with blue mats.	R1014-222
00:30:27	1525	348	45.92641	-129.97934	We have taken lots of DSCs of the blue mat and now we will take a suction sample.	
00:33:59	1525	252	45.92648	-129.97934	We are going to sample with jar 3.	R1014-223
00:34:20	1525	252	45.92648	-129.97934	Blue mats at Diva. We are getting ready to sample.	R1014-224
00:36:24	1525	267	45.92647	-129.97934	A close up of the blue mats.	R1014-225
00:41:48	1525	266	45.92648	-129.97934	A wider angle shot of our sample area.	R1014-226
00:42:34	1525	266	45.92648	-129.97934	We are checking to see how much we have collected.	R1014-227
00:44:01	1525	282	45.92647	-129.97933	Suctioning blue mats into jar #3 with a 200 micron double mesh sieve. Z=1525. Diva. **R1014-SS-0024 (Kouris)**	
00:44:21	1525	282	45.92647	-129.97933	We are now sampling for real into jar 3.	R1014-228
00:47:21	1525	283	45.92653	-129.97941	We are still sampling.	R1014-229
00:48:12	1525	283	45.92652	-129.97941	We are checking to see our sample volume.	R1014-230
00:50:30	1525	283	45.92645	-129.97959	Still sampling.	R1014-231
00:53:04	1525	288	45.92645	-129.97960	A pretty good looking suction sample.	
00:53:34	1525	288	45.92645	-129.97960	Checking our sample.	R1014-232
00:54:58	1525	287	45.92645	-129.97960	We are going to take a temperature measurement of the vent Diva.	
00:55:00	1525	287	45.92645	-129.97960	We are going to take a water temperature measurement of Diva.	R1014-233
00:56:04	1525	287	45.92645	-129.97960	Temperature measurements on the mat; 3.0°C; 3.8°C; 4.8°C; 3.0°C; 3.5°C; Ambient:	
00:56:06	1525	287	45.92645	-129.97960	Taking temperature measurements on the mat.	R1014-234
00:57:39	1525	287	45.92645	-129.97961	Sampling the water temp at another location on the same mat.	R1014-235
00:59:04	1525	288	45.92645	-129.97960	Sampling temperature at a third site near Virgin - 3.5 degrees C.	R1014-236
01:01:27	1525	288	45.92645	-129.97960	We are collecting a grab sample of the blue mats.	R1014-237
01:01:27	1525	288	45.92645	-129.97960	Took a grab of hydrothermal sediment and rock with blue mat on it. Going in to the purse. Z=1525. Diva. **R1014-Bio-0025 (Kouris)**	
01:02:55	1522	331	45.92645	-129.97961	En route to the southwest.	R1014-238
01:02:58	1522	358	45.92645	-129.97962	Heading to the southwest to look at the base of the wishbone feature on the map.	
01:04:20	1526	104	45.92651	-129.97950	Hydrothermal sediments and a lava ridge.	
01:04:46	1524	118	45.92651	-129.97944	Crossing a lava ridge and turning to go southwest.	R1014-239
01:04:47	1524	107	45.92650	-129.97944	Turning and heading southwest to explore further.	
01:06:10	1524	263	45.92641	-129.97956	A small diffuse venting mound with tubeworms.	
01:06:12	1524	266	45.92641	-129.97957	Diffuse vent site.	R1014-240
01:07:00	1523	271	45.92632	-129.97980	Heading west and tracking along a small ridge.	
01:07:05	1524	273	45.92631	-129.97985	Sediment covered seafloor traversed while moving west.	R1014-241
01:07:33	1523	284	45.92632	-129.97994	Another **large dead chimney** ahead that we have seen before. Calling it **Batman.**	
01:07:35	1523	295	45.92632	-129.97995	Batman. By the way, Batman is not hydrothermally active.	R1014-242
01:09:41	1519	275	45.92624	-129.98005	Facing west again.	
01:10:11	1522	272	45.92622	-129.98006	On the traverse west.	R1014-243
01:11:18	1518	268	45.92622	-129.98028	Another huge flat top ahead. Oh it is **Flat Top.**	
01:11:18	1518	268	45.92622	-129.98028	Flat Top.	R1014-244
01:12:15	1508	28	45.92625	-129.98037	Turning to the northeast now.	
01:12:43	1515	32	45.92624	-129.98037	Crab atop a small dead chimney.	R1014-245
01:14:07	1520	4	45.92645	-129.98030	Chimneys.	R1014-246
01:14:12	1520	4	45.92645	-129.98030	Broken chimney complex here. We have seen this one before too. It is **Top Gun.**	
01:19:16	1519	135	45.92631	-129.98024	Moving the ship so we can approach this area from the east.	
01:21:13	1524	101	45.92607	-129.97973	Ropy lava while waiting for the ship to turn.	R1014-247
01:21:48	1525	101	45.92602	-129.97948	Collapsed lava pillow.	R1014-248
01:23:19	1526	7	45.92623	-129.97939	Area of former venting.	R1014-249
01:24:10	1525	342	45.92642	-129.97940	We are now heading back to the north end of this chimney area. There is a small venting area here.	
01:24:44	1523	289	45.92646	-129.97948	Area of diffuse flow.	R1014-250

Time	Z	Hdg	raw lat	raw long	R1014 Comments: SE Caldera (Axial)	FrGrab
01:25:22	1521	269	45.92647	-129.97969	Approaching Escargot.	R1014-251
01:26:05	1520	284	45.92644	-129.97973	We have seen this **large chimney** before. We are calling it **Escargot** due to the snail-looking bit on top of the flange.	
01:26:14	1520	291	45.92644	-129.97974	Blue mat on flange on Escargot.	R1014-252
01:27:15	1519	224	45.92648	-129.97975	The under side of the flange was covered with blue mat. The entire chimney is about 9 meters tall.	
01:27:32	1518	260	45.92646	-129.97973	Image of the snail on Escargot.	R1014-253
01:28:35	1517	316	45.92640	-129.97975	Top of Escargot.	R1014-254
01:28:59	1520	350	45.92639	-129.97977	Tube worm community on Escargot.	R1014-255
01:29:03	1520	337	45.92640	-129.97975	There are a lot of tubeworms and some blue mat down the sides of the chimney as well.	
01:29:23	1521	239	45.92647	-129.97973	More blue mat.	R1014-256
01:31:27	1522	308	45.92649	-129.97975	Bacterial mat with blue mat in it.	R1014-257
01:32:11	1523	304	45.92651	-129.97978	Another patch of diffuse venting here.	
01:32:23	1521	295	45.92654	-129.97984	Approach to **another new large chimney**. Named her **"Hermosa"** - company for Guapo. She looks like a woman's profile at the top. They're both a couple beautiful chimneys.	R1014-258
01:32:40	1518	290	45.92654	-129.97986	Here is another large chimney as we head west. We haven't seen this one before. It is active. Calling it Hermosa.	
01:33:44	1520	307	45.92657	-129.97985	Continuing north.	
01:34:02	1520	242	45.92660	-129.97988	Close up of some of the biology on the new chimney called Hermosa. This one is probably the chimney at the west end of the "wishbone" feature in the bathymetry.	R1014-259
01:36:53	1519	312	45.92679	-129.98013	Interesting lava pillows.	R1014-260
01:36:56	1519	312	45.92679	-129.98015	Pillow lavas.	
01:37:58	1516	200	45.92665	-129.98027	Here is another enormous structure. It appears to be dead. We were heading south when we found this one. It is the other side of a broken top chimney we have seen.	
01:38:00	1516	204	45.92664	-129.98027	Approaching another dead chimney.	R1014-261
01:39:43	1517	204	45.92662	-129.98032	Going back for one last look at El Guapo before we leave.	
01:40:02	1515	77	45.92658	-129.98030	Last approach of El Guapo.	R1014-262
01:40:48	1509	76	45.92659	-129.98022	The top of El Guapo.	R1014-263
01:41:31	1509	182	45.92663	-129.98017	Top of El Guapo.	R1014-264
01:42:10	1508	280	45.92660	-129.98011	El Guapo with bubbles around it.	R1014-265
01:44:23	1509	338	45.92658	-129.98015	El Guapo's pipes.	R1014-266
01:46:04	1511	15	45.92657	-129.98018	Base of El Guapo.	R1014-267
01:49:50	1502	160	45.92656	-129.98010	That's all she wrote. We are leaving the bottom.	
01:50:16	1497	172	45.92657	-129.98008	Videos are all stopped.	
03:02:50	1373	224	45.92680	-129.98012	ROPOS is at the surface. End of dive R1014.	
03:06:27	1373	224	45.92680	-129.98012	ROPOS is on deck.	

Appendix: Deployment data downloaded from recovered time-series samplers

RAS 16 at Mothra, Tower

Software version: ras500_4.c
Compiled: Sep 26 2002 11:05:34
Electronics S/N: ML11605-02

Data recording start time = 09/20/2005 10:47:13
Data recording stop time = 07/24/2006 12:15:45

HEADER

RAS11605-02 at Mothra Sept04 to July05 every 6 days
filters: mult of 3 are GTTP 0.2um, others GFF .7micron
MTR 3173, RAS clock set to UTC

SAMPLE PARAMETERS

Sample volume [ml] = 480
Sample time limit [minutes] = 25
Water flush volume [ml] = 100
Water flush time limit [minutes] = 5
Acid flush volume [ml] = 10
Acid flush time limit [minutes] = 1
Acid exposure delay [minutes] = 5

SCHEDULE

Event 1 of 48 @ 10/15/2005 12:00:00
Event 2 of 48 @ 10/21/2005 12:00:00
Event 3 of 48 @ 10/27/2005 12:00:00
Event 4 of 48 @ 11/02/2005 12:00:00
Event 5 of 48 @ 11/08/2005 12:00:00
Event 6 of 48 @ 11/14/2005 12:00:00
Event 7 of 48 @ 11/20/2005 12:00:00
Event 8 of 48 @ 11/26/2005 12:00:00
Event 9 of 48 @ 12/02/2005 12:00:00
Event 10 of 48 @ 12/08/2005 12:00:00
Event 11 of 48 @ 12/14/2005 12:00:00
Event 12 of 48 @ 12/20/2005 12:00:00
Event 13 of 48 @ 12/26/2005 12:00:00
Event 14 of 48 @ 01/01/2006 12:00:00
Event 15 of 48 @ 01/07/2006 12:00:00
Event 16 of 48 @ 01/13/2006 12:00:00
Event 17 of 48 @ 01/19/2006 12:00:00
Event 18 of 48 @ 01/25/2006 12:00:00
Event 19 of 48 @ 01/31/2006 12:00:00

Event 20 of 48 @ 02/06/2006 12:00:00
Event 21 of 48 @ 02/12/2006 12:00:00
Event 22 of 48 @ 02/18/2006 12:00:00
Event 23 of 48 @ 02/24/2006 12:00:00
Event 24 of 48 @ 03/02/2006 12:00:00
Event 25 of 48 @ 03/08/2006 12:00:00
Event 26 of 48 @ 03/14/2006 12:00:00
Event 27 of 48 @ 03/20/2006 12:00:00
Event 28 of 48 @ 03/26/2006 12:00:00
Event 29 of 48 @ 04/01/2006 12:00:00
Event 30 of 48 @ 04/07/2006 12:00:00
Event 31 of 48 @ 04/13/2006 12:00:00
Event 32 of 48 @ 04/19/2006 12:00:00
Event 33 of 48 @ 04/25/2006 12:00:00
Event 34 of 48 @ 05/01/2006 12:00:00
Event 35 of 48 @ 05/07/2006 12:00:00
Event 36 of 48 @ 05/13/2006 12:00:00
Event 37 of 48 @ 05/19/2006 12:00:00
Event 38 of 48 @ 05/25/2006 12:00:00
Event 39 of 48 @ 05/31/2006 12:00:00
Event 40 of 48 @ 06/06/2006 12:00:00
Event 41 of 48 @ 06/12/2006 12:00:00
Event 42 of 48 @ 06/18/2006 12:00:00
Event 43 of 48 @ 06/24/2006 12:00:00
Event 44 of 48 @ 06/30/2006 12:00:00
Event 45 of 48 @ 07/06/2006 12:00:00
Event 46 of 48 @ 07/12/2006 12:00:00
Event 47 of 48 @ 07/18/2006 12:00:00
Event 48 of 48 @ 07/24/2006 12:00:00

RAS 17 at SW Hulk

Software version: ras500_4.c
Compiled: Sep 26 2002 11:05:34
Electronics S/N: ML11605-01

Data recording start time = 09/20/2005 10:33:22
Data recording stop time = 07/24/2006 12:18:36

HEADER

RAS11605-02 with PPS11605-03 2005-2006
SW Hulk diffuse flow site
MTR#3334, GFF1,2, GTTP mult of 3

SAMPLE PARAMETERS

Sample volume [ml] = 480
Sample time limit [minutes] = 25

Water flush volume [ml] = 100
Water flush time limit [minutes] = 5
Acid flush volume [ml] = 10
Acid flush time limit [minutes] = 1
Acid exposure delay [minutes] = 3

SCHEDULE

Event 1 of 48 @ 10/15/2005 12:05:00
Event 2 of 48 @ 10/21/2005 12:05:00
Event 3 of 48 @ 10/27/2005 12:05:00
Event 4 of 48 @ 11/02/2005 12:05:00
Event 5 of 48 @ 11/08/2005 12:05:00
Event 6 of 48 @ 11/14/2005 12:05:00
Event 7 of 48 @ 11/20/2005 12:05:00
Event 8 of 48 @ 11/26/2005 12:05:00
Event 9 of 48 @ 12/02/2005 12:05:00
Event 10 of 48 @ 12/08/2005 12:05:00
Event 11 of 48 @ 12/14/2005 12:05:00
Event 12 of 48 @ 12/20/2005 12:05:00
Event 13 of 48 @ 12/26/2005 12:05:00
Event 14 of 48 @ 01/01/2006 12:05:00
Event 15 of 48 @ 01/07/2006 12:05:00
Event 16 of 48 @ 01/13/2006 12:05:00
Event 17 of 48 @ 01/19/2006 12:05:00
Event 18 of 48 @ 01/25/2006 12:05:00
Event 19 of 48 @ 01/31/2006 12:05:00
Event 20 of 48 @ 02/06/2006 12:05:00
Event 21 of 48 @ 02/12/2006 12:05:00
Event 22 of 48 @ 02/18/2006 12:05:00
Event 23 of 48 @ 02/24/2006 12:05:00
Event 24 of 48 @ 03/02/2006 12:05:00
Event 25 of 48 @ 03/08/2006 12:05:00
Event 26 of 48 @ 03/14/2006 12:05:00
Event 27 of 48 @ 03/20/2006 12:05:00
Event 28 of 48 @ 03/26/2006 12:05:00
Event 29 of 48 @ 04/01/2006 12:05:00
Event 30 of 48 @ 04/07/2006 12:05:00
Event 31 of 48 @ 04/13/2006 12:05:00
Event 32 of 48 @ 04/19/2006 12:05:00
Event 33 of 48 @ 04/25/2006 12:05:00
Event 34 of 48 @ 05/01/2006 12:05:00
Event 35 of 48 @ 05/07/2006 12:05:00
Event 36 of 48 @ 05/13/2006 12:05:00
Event 37 of 48 @ 05/19/2006 12:05:00
Event 38 of 48 @ 05/25/2006 12:05:00
Event 39 of 48 @ 05/31/2006 12:05:00
Event 40 of 48 @ 06/06/2006 12:05:00
Event 41 of 48 @ 06/12/2006 12:05:00
Event 42 of 48 @ 06/18/2006 12:05:00

Event 43 of 48 @ 06/24/2006 12:05:00
Event 44 of 48 @ 06/30/2006 12:05:00
Event 45 of 48 @ 07/06/2006 12:05:00
Event 46 of 48 @ 07/12/2006 12:05:00
Event 47 of 48 @ 07/18/2006 12:05:00
Event 48 of 48 @ 07/24/2006 12:05:00

PPS Deployed with RAS 17 at SW Hulk Site

Software version: wts1_9.c
Compiled: Sep 26 2002 11:25:14
Electronics S/N: ML11605-03

Data recording start time = 09/20/2005 09:27:46
Data recording stop time = 07/24/2006 12:45:54

HEADER

PPS at MEF ulk diffuse site 2005-2006
Flat area of diffuse flow on east side of fissure
to the SW of Hulk, .22um nitrocellulose, NaCl/EtOH buffer

SAMPLE PARAMETERS

Initial flow rate [ml/min] = 125
Minimum flow rate [ml/min] = 20
Sample volume [ml] = 3000
Time limit [minutes] = 151
Flushing water volume [ml] = 400

SCHEDULE

Event 1 of 24 @ 10/21/2005 12:00:00
Event 2 of 24 @ 11/02/2005 12:00:00
Event 3 of 24 @ 11/14/2005 12:00:00
Event 4 of 24 @ 11/26/2005 12:00:00
Event 5 of 24 @ 12/08/2005 12:00:00
Event 6 of 24 @ 12/20/2005 12:00:00
Event 7 of 24 @ 01/01/2006 12:00:00
Event 8 of 24 @ 01/13/2006 12:00:00
Event 9 of 24 @ 01/25/2006 12:00:00
Event 10 of 24 @ 02/06/2006 12:00:00
Event 11 of 24 @ 02/18/2006 12:00:00
Event 12 of 24 @ 03/02/2006 12:00:00
Event 13 of 24 @ 03/14/2006 12:00:00
Event 14 of 24 @ 03/26/2006 12:00:00
Event 15 of 24 @ 04/07/2006 12:00:00
Event 16 of 24 @ 04/19/2006 12:00:00

Event 17 of 24 @ 05/01/2006 12:00:00
Event 18 of 24 @ 05/13/2006 12:00:00
Event 19 of 24 @ 05/25/2006 12:00:00
Event 20 of 24 @ 06/06/2006 12:00:00
Event 21 of 24 @ 06/18/2006 12:00:00
Event 22 of 24 @ 06/30/2006 12:00:00
Event 23 of 24 @ 07/12/2006 12:00:00
Event 24 of 24 @ 07/24/2006 12:00:00

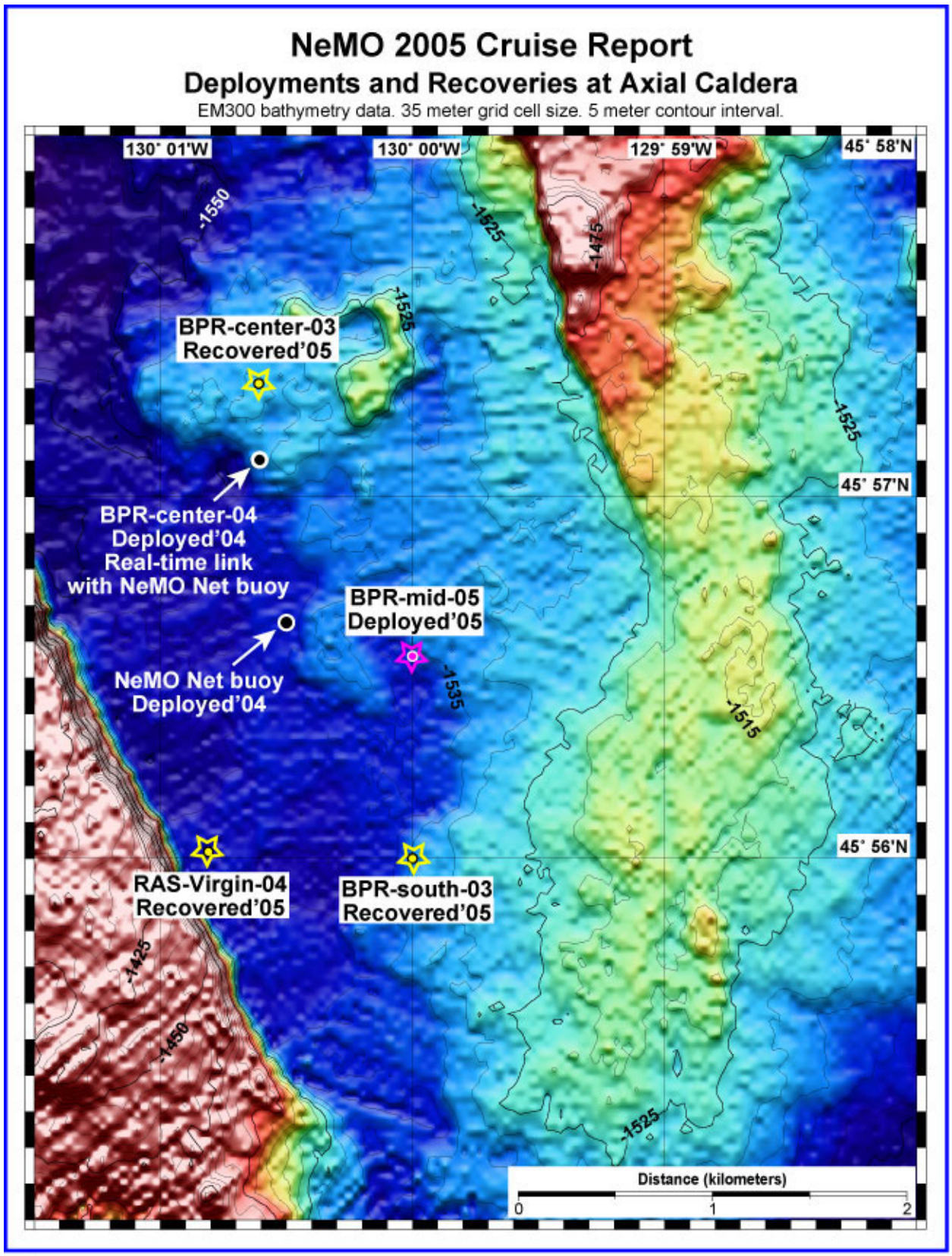
NeMO 2005 Cruise Report
Deployments and Recoveries at Axial Caldera
EM300 bathymetry data. 35 meter grid cell size. 5 meter contour interval.
130° 01'W
130° 00'W
129° 59'W
45° 58'N
45° 57'N
45° 56'N
-1550
-1525
-1475
-1525
-1525
-1525
-1515
-1535
-1425
-1450
-1525
BPR-center-03
Recovered'05
BPR-center-04
Deployed'04
Real-time link
with NeMO Net buoy
NeMO Net buoy
Deployed'04
BPR-mid-05
Deployed'05
RAS-Virgin-04
Recovered'05
BPR-south-03
Recovered'05
Distance (kilometers)
0
1
2

Figure 18

figure 18 back

NeMO 2005 Cruise Science Summary
R/V *Wecoma* May 10-12, 2005
Dave Butterfield, Chief Scientist

The PMEL/Vents Program has been monitoring Axial Volcano with the NeMO project since 1998. The real-time data transmission system, NeMO-Net, began in 1999, and was improved and/or modified each year. From 2003 to 2005, the configuration of NeMO-Net was stable, with one interactive Remote Access Sampler (RAS) for vent fluid and particles deployed at Virgin Mound vent, and one real-time reporting Bottom Pressure Recorder (BPR).

In 2005, there was a crisis in ship-time funding that prevented us from staging a remotely-operated vehicle cruise. We elected to recover the RAS, while leaving the real-time buoy and BPR in place. This will maintain the real-time data stream, save significant resources this year, and potentially allow us to resume time-series sampling at Axial in 2006. The long-term goal is to monitor a complete cycle at Axial from eruption to eruption.

The goals for the 2005 *Wecoma* cruise were to recover and process the RAS time-series sampler, recover the two self-recording BPRs that were deployed in 2003, download their data, and re-deploy them for another two years. A secondary goal was to conduct CTD operations to measure hydrothermal plume intensity in the Axial caldera.

All instruments were acoustically released from their anchors and recovered with no problem. The complete RAS instrument was taken on board with cables and funnel intact. The downloaded data from BPR-south-03 did not appear normal, and after consultation with EDD personnel on shore, it was decided not to re-deploy that instrument. The other BPR was refurbished and re-deployed at the mid-caldera position (see cruise log).

Three CTD casts were performed at known vent sites: Over Mushroom vent in the ASHES field, over marker N3 site, and over Snail vent (near Marker 33 vent). A caldera "background" cast was done away from known vent sites near the mid-caldera BPR site. Equipment for filtering Niskins and collecting helium samples was not available for this cruise. Samples were taken for total dissolvable metals and for potential pH anomaly measurement on shore.

NeMO 2005 Scientific Personnel

Dave Butterfield	Chief Scientist, University of Washington / NOAA Vents Program
Sheryl Bolton	University of Washington
Randy Bott	PMEL Engineering
Susan Merle	Oregon State University / NOAA Vents Program
John Shanley	PMEL Engineering

Operations Log Nemo 2005 Cruise W0505A - R/V *Wecoma* - Axial Volcano - May 10 - May 12						
Date (PST)	Time (PST)	Comments	Lat °	Lat '	Long °	Long '
PST is 7 hours behind UTC						
10-May	800	Depart Newport				
11-May	700	Arrive Axial				
	710	Released BPRsouth03	45	56	130	0
	750	BPR at the surface.				
	800	BPR-south-03 on deck.				
nemoe4.dat data file showed that the flash card was not functioning. Have pressure period all the way thru the year but height (mm) and temperature period stopped on 9/3/03. Have the temp data in deg C and pressure period (tidal fluctuations). On Scott Stalin's advice, it was not re-deployed.						
	832	Sent RAS release code. Confirmed and coming up at 35 m/min.				
	930	RAS at the surface (was at Virgin)	45	56.019	130	0.809
	950	RAS on board.				
RAS collected samples in all bottles, except for one (#17 had a closed valve). Removed intake lines and T1 cable. Removed Eh sensor and soaked in water. In situ preserved DNA filters were frozen immediately. Water samples were put on ice. GFF filters were rinsed with ~5ml MQ, suction dried, and air dried in petri slides.						
	1130	BPR-center-03 at the surface	45	57.313	130	0.61
	1140	BPR-center-03 on board				
nem4oe3.dat data file showed a drop out point at the same time and day that the nemoe4.dat file showed a drop out. After that point the data came back and looks OK.						
	1300	CTD cast 1 at ASHES (cast01.dat) in the water.	45	56.016	130	0.828
At 1550 m we saw a slight temperature and transmissometer spike. Filled 12 bottles, but bottles 4 and 6 didn't fill. Seasav2 is the program the marine techs were using (Marc and Dave are the techs).						
	1405	CTD cast 1 at ASHES back on deck.				
For processing of CTD water, we are taking pH samples in 60ml bottles by filling from a tube with no air and capping. Also took total dissolvable metal samples in 250ml or 500ml acid cleaned hdpe bottles. TM bottles were rinsed 3 times and then filled.						
	1440	Lining up to deploy BPRmiddle05				
	1445	BPRmiddle05 in the water.				
	1448	Drop position at the stern. 186 deg bearing.	45	56.559	130	0
BPR-middle-05 (also known as E-3 by PMEL engineers) has a mooring line ~30 meters long. The flash card from BPRcenter03 was used in BPRmiddle05. A new release was used.						
	1520	CTD cast 2 at Mkr-N3 (cast02.dat) in the water.	45	56.628	129	59.112
	1632	CTD cast 2 at Mkr-N3 back on deck.				
	1700	CTD cast 3 at Snail (cast03.dat) in the water.	45	55.992	129	58.914
	1818	CTD cast 3 at Snail back on deck				
	1838	CTD cast 4 Background (cast04.dat) in the water.	45	56.3	130	0

Operations Log Nemo 2005 Cruise W0505A - R/V *Wecoma* - Axial Volcano - May 10 - May 12						
Date (PST)	Time (PST)	Comments	Lat °	Lat ‘	Long °	Long ‘
	1950	CTD cast 4 Background back on deck.				
	2000	Heading back to Newport.				
12-May	1815	Back at the pier in Newport. End of cruise.				

NeMO Instrument Positions

Instrument / Experiment	Long (deg)	Long (min)	Lat (deg)	Lat (min)	Z (m)	Deployed / Recovered
Buoy-04	130	0.4998	45	56.65		Depl NeMO'04
BPR-center-04	130	00.50	45	57.10		Depl 10/31/04 (postcruise'04)
BPR-center-03	130	0.61	45	57.313	1534	Depl NeMO'03 / Rec NeMO'05
BPR-south-03						Depl NeMO'03 / Rec NeMO'05
BPR-middle-05 (E-3)	130	0	45	56.559		Depl NeMO'05
RAS-04 (at Virgin)	130	0.80899	45	56.019	1547	Depl NeMO'04 / Rec NeMO'05

BPR-middle-05 (mooring # E-3)
Deployed 5/11/05, Type 8242, Serial # 022764, Paros Serial # 40992