Axial 2013 Cruise Report

Axial Seamount, Juan de Fuca Ridge

R/V Thompson TN 300
September 3–19, 2013
JASON Dives J2-726 – J2-732

Chief Scientist: Bill Chadwick
R/V Thompson Captain: Eric Haroldson
JASON Expedition Leader: Matt Heintz
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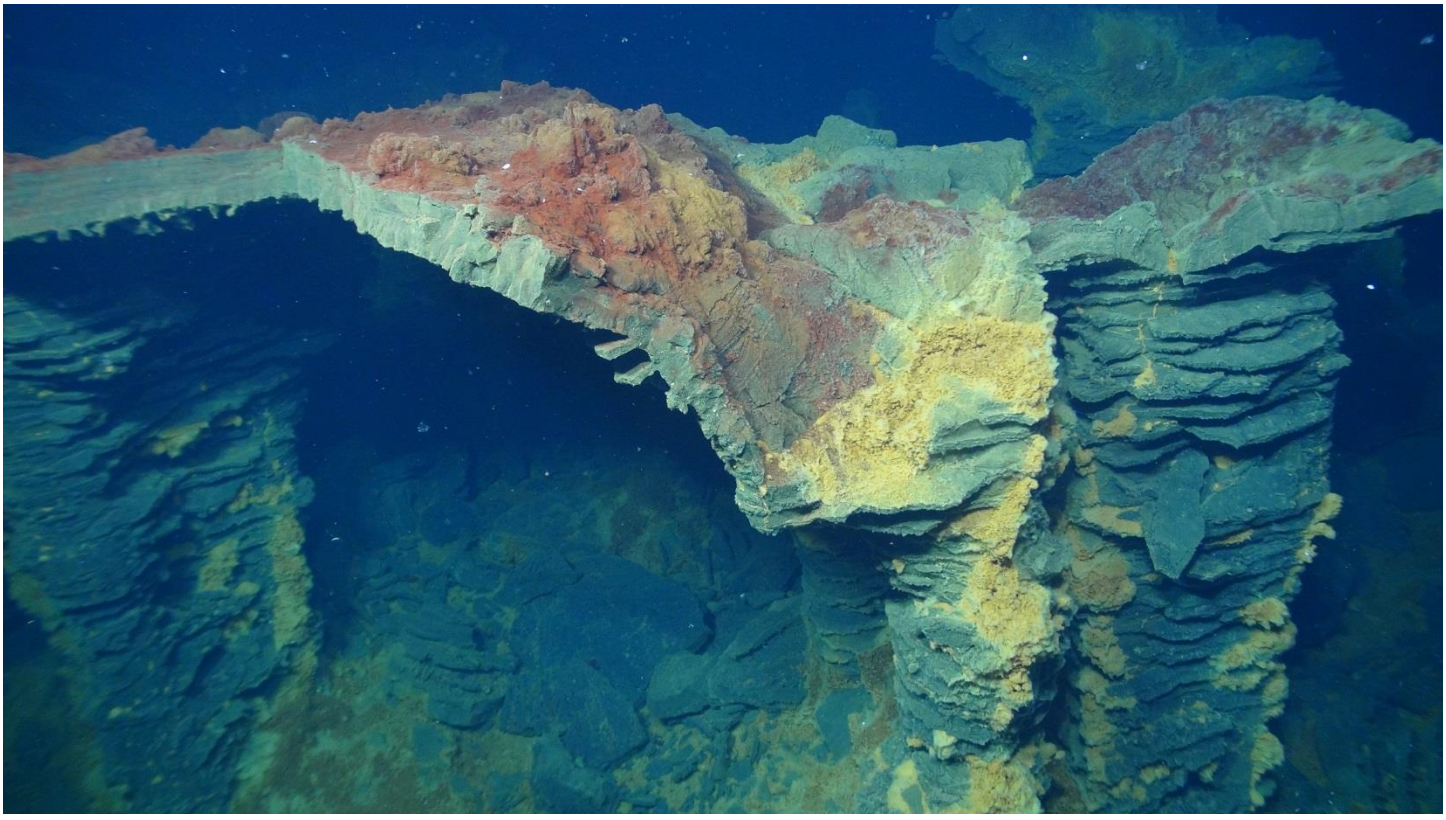

Red Bridges site, area of collapsed 2011 lava flow and red mat. Explored on dives J730 and J732.

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Axial 2013 Expedition Cruise Report

1 - Expedition Summary

Bill Chadwick, Chief Scientist

Our September 3-19, 2013 expedition to Axial Seamount was a great success! We completed all our major goals with the skilled support of the R/V Thompson's crew, the ROV Jason team, and our hard-working group of scientists. We also had unusually good weather, which always makes everything easier at sea. This research cruise had three main projects that were piggybacked together.

One project was to collect fluid and microbial samples from Axial's hydrothermal vents to better understand their microbial ecosystems. We collected samples of hydrothermal vent fluid to track changes in chemistry since Axial's 2011 eruption and how those changes may affect the microbial communities. We used a range of samplers to collect vent fluids, gases, microbial mat, and hydrothermal sediments. We also collected the microbes living in the vent fluids for culturing experiments on board the ship and genetic analysis back on shore. This work was accomplished during Jason dives J2-726, J2-728, and J2-731. This project was led by Dave Butterfield and Jim Holden, and was funded by NOAA/PMEL and the Gordon and Betty Moore Foundation.

The second project was a geothermal energy experiment that deployed prototype instruments on the seafloor to assess the feasibility of converting thermal energy from hydrothermal vents to electrical energy that could be used to power deep-sea sensors or underwater vehicles in the future. Geothermal energy devices were successfully placed on three separate hydrothermal vents (Vixen, Virgin, and Trevi) during Jason dives J2-727, J2-729, and J2-732. The devices will stay deployed for the next year and continue to collect data until they are recovered next summer. The results from this experiment will guide the design of more advanced energy conversion devices in the future. This project was led by Dave Dyer and was funded by the Office of Naval Research.

The third project was to monitor how much the volcano has reinflated since its last eruption in 2011 by making seafloor pressure measurements at an array of seafloor benchmarks. This was accomplished during one long Jason dive, J2-730, which lasted almost 5 days and repeatedly visited 10 different measurement sites, traversing a total of 65 km. We found that the center of Axial's caldera had risen by 1.22 meters in the last 2 years, the highest rate of uplift we've seen since we started these measurements over a decade ago. This means the volcano has already recovered over half of the deflation that occurred during the April 2011 eruption, and suggests that Axial may be closer to its next eruption than we expected. This project was led by Scott Nooner and Bill Chadwick, and was funded by the National Science Foundation.

In between the Jason dives, we recovered 3 OBH instruments, deployed 1 OBH and 3 BPR instruments, 1 self-calibrating pressure recorder (SCPR), 6 cement benchmarks, 1 RAS instrument, and we used elevator moorings to transport the geothermal devices to the seafloor. We also conducted 6 CTD casts and collected multibeam sonar data with the Thompson's EM122 system. We deployed a surface buoy at the beginning of the cruise to communicate with the geothermal devices on the seafloor, but it had to be recovered at the end, because it was not functioning properly.

During the cruise, we also conducted outreach activities, led by our teacher-at-sea, Rachel Teasdale. Before the cruise, she made contacts with classroom teachers in California, Oregon, and Washington, and each of these teachers had their classes follow our cruise blog, which we posted to at sea: axial2013.blogspot.com. Then during the cruise we made a Skype call from the ship to each of their classrooms and had a 30-60 minute question-and-answer session with the students.

We are grateful to the funding agencies that supported our research, and we greatly appreciate the support from the University of Washington, the captain and crew of R/V Thompson, the Woods Hole Oceanographic Institution, the National Deep Submergence Facility, and the Jason ROV team. Thanks to all for making this cruise such a success.

2 - Cruise Participants

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3 - Operations Log

(GMT was 7 hours ahead of local time)

Local Time	GMT Time	Event
9/3/2013 05:30	9/3/2013 12:30	Departed University of Washington Pier, Seattle.
9/4/2013 09:00	9/4/2013 16:00	XBT for EM302 system SVP conducted.
9/4/2013 09:27	9/4/2013 16:27	EM302 logging on/off (problem with SVP).
9/4/2013 14:25	9/4/2013 21:25	Begin APL buoy deployment.
9/4/2013 17:05	9/5/2013 00:05	APL buoy anchor dropped (45°55.228'N 130°0.758'W z=1484m).
9/4/2013 17:30	9/5/2013 00:30	APB buoy anchor release signal verified.
9/4/2013 19:11	9/5/2013 02:11	CTD V13A-01 / TN300-01-01 (45°55.921'N 130°8.765'W z=1693m) Background CTD.
9/4/2013 20:29	9/5/2013 03:29	CTD on board.
9/4/2013 21:53	9/5/2013 04:53	CTD V13A-02 / TN300-02-01 (45°56.808'N 129°58.958'W) Trevi Vent CTD.
9/4/2013 23:13	9/5/2013 06:13	CTD on board.
9/5/2013 01:35	9/5/2013 08:35	JASON USBL calibration begun.
9/5/2013 05:30	9/5/2013 12:30	JASON USBL calibration completed; pole on board.
9/5/2013 09:05	9/5/2013 16:05	BPR Center deployed (45°57.418'N 130°0.661'W)
9/5/2013 10:05	9/5/2013 17:05	BPR South-1 deployed (45°55.910'N 129°59.951'W)
9/5/2013 10:56	9/5/2013 17:56	BPR South-2 deployed (45°54.957'N 129°59.622'W)
9/5/2013 11:55	9/5/2013 18:55	OBH-3 West release code sent.
9/5/2013 12:15	9/5/2013 19:15	OBH-3 West on surface.
9/5/2013 12:46	9/5/2013 19:46	OBH-3 on board.
9/5/2013 13:05	9/5/2013 20:05	OBH-2 East release code sent.
9/5/2013 13:28	9/5/2013 20:28	OBH-2 East on surface.
9/5/2013 13:50	9/5/2013 20:50	OBH-2 on board. (Note: instrument was flooded.)
9/5/2013 14:34	9/5/2013 21:34	BPR Center location survey (Workboat) begun.
9/5/2013 14:50	9/5/2013 21:50	BPR Center survey complete.
9/5/2013 15:23	9/5/2013 22:23	BPR South-2 location survey begun.
9/5/2013 15:50	9/5/2013 22:50	BPR South-2 survey stopped for JASON deployment (incomplete).
9/5/2013 16:24	9/5/2013 23:24	**JASON in water. J2-726** APL vent cap deployment at Vixen Vent.
9/6/2013 08:20	9/6/2013 15:20	JASON on deck. End J2-726.
9/6/2013 10:01	9/6/2013 17:01	AX-307 benchmark deployed (45°56.739'N 130°0.584'W).
9/6/2013 11:12	9/6/2013 18:12	AX-308 benchmark deployed (45°55.900'N 129°59.942'W).
9/6/2013 16:50	9/6/2013 23:50	APL elevator deployed over Coquille (45°55.036'N 129deg 59.581'W).
9/6/2013 19:02	9/7/2013 02:02	**JASON in water. J2-727** at ASHES.
9/6/2013 23:15	9/7/2013 06:15	APL elevator released from seafloor.
9/6/2013 23:43	9/7/2013 06:43	APL elevator at surface.
9/7/2013 00:32	9/7/2013 07:32	APL elevator on board.
9/7/2013 12:15	9/7/2013 19:15	JASON on deck. End J2-727.
9/7/2013 13:05	9/7/2013 20:05	AX-303 benchmark deployed (45°56.01'N -129°58.93'W).
9/7/2013 13:35	9/7/2013 20:35	AX-310 benchmark deployed (45°55.474'N 129°58.665'W)
9/7/2013 15:23	9/7/2013 22:23	RAS deployed (45°55.496'N 129°58.741'W).
9/7/2013 16:40	9/7/2013 23:40	SCPR mooring begin deployment on ship's wire.
9/7/2013 18:18	9/8/2013 01:18	SCPR mooring deployed (45°46.144'N 130°00.730'W).

(GMT was 7 hours ahead of local time)

Local Time	GMT Time	Event
9/7/2013 20:03	9/8/2013 03:03	**JASON in water. J2-728** at International District.
9/8/2013 12:45	9/8/2013 19:45	AX-302 benchmark deployed (45°56.79'N 129°58.96'W).
9/8/2013 13:15	9/8/2013 20:15	AX-309 benchmark deployed (45°56.32'N 129°58.32'W).
9/8/2013 14:25	9/8/2013 21:25	APL elevator deployed over ASHES (45°55.922'N 130°0.719'W)
9/8/2013 15:33	9/8/2013 22:33	OBH 4-North position survey begun (prior recovery).
9/8/2013 16:12	9/8/2013 23:12	OBH 4-North survey complete.
9/8/2013 17:10	9/9/2013 00:10	OBH 4-North on deck
9/8/2013 17:13	9/9/2013 00:13	BPR South-1 begin position survey.
9/8/2013 18:35	9/9/2013 01:35	BPR South-1 survey complete.
9/8/2013 19:04	9/9/2013 02:04	BPR South-2 begin position survey.
9/8/2013 19:27	9/9/2013 02:27	BPR south-2 survey complete.
9/8/2013 20:00	9/9/2013 03:00	**JASON in water. J2-729** at ASHES (APL vent cap deployment at Virgin Vent).
9/9/2013 01:23	9/9/2013 08:23	APL elevator released from seafloor.
9/9/2013 01:50	9/9/2013 08:50	APL elevator on surface.
9/9/2013 02:10	9/9/2013 09:10	APL elevator on board.
9/9/2013 08:48	9/9/2013 15:48	JASON on deck. End J2-729.
9/9/2013 10:14	9/9/2013 17:14	OBH South deployed (45°55.0845'N 129°58.9076'W).
9/9/2013 10:56	9/9/2013 17:56	OBH South begin position survey.
9/9/2013 11:40	9/9/2013 18:40	OBH South survey complete.
9/9/2013 16:11	9/9/2013 23:11	**JASON in water. J2-730** 5-day pressure dive begins.
9/9/2013 18:17	9/10/2013 01:17	AX-308 floats released by JASON.
9/9/2013 18:50	9/10/2013 01:50	AX-308 benchmark floats recovered.
9/10/2013 06:31	9/10/2013 13:31	AX-302 floats released by JASON.
9/10/2013 07:00	9/10/2013 14:00	AX-302 benchmark floats recovered (time approximate).
9/10/2013 10:21	9/10/2013 17:21	AX-309 floats released by JASON.
9/10/2013 11:02	9/10/2013 18:02	AX-309 benchmark floats recovered.
9/10/2013 13:44	9/10/2013 20:44	AX-303 floats released by JASON.
9/10/2013 14:13	9/10/2013 21:13	AX-303 benchmark floats recovered.
9/10/2013 16:27	9/10/2013 23:27	AX-310 floats released by JASON.
9/10/2013 17:05	9/11/2013 00:05	AX-310 benchmark floats recovered.
9/11/2013 19:02	9/12/2013 02:02	AX-307 floats released by JASON.
9/11/2013 19:36	9/12/2013 02:36	AX-307 benchmark floats recovered.
9/14/2013 12:13	9/14/2013 19:13	JASON on deck. End J2-730.
9/14/2013 13:00	9/14/2013 20:00	CTD V13A-03 / TN300-003-01 (45°55.569'N 129°58.807'W) Castle Vent.
9/14/2013 14:30	9/14/2013 21:30	Transit to Dependable Vent Field. EM302 logging on.
9/14/2013 15:35	9/14/2013 22:35	EM302 logging off.
9/14/2013 16:45	9/14/2013 23:45	**JASON in water. J2-731** Dependable Vent Field.
9/15/2013 08:16	9/15/2013 15:16	JASON on deck. End J2-731.
9/15/2013 10:01	9/15/2013 17:01	APL deployed over Trevi Vent (45°56.772'N 129°58.916'W).
9/15/2013 12:05	9/15/2013 19:05	**JASON in water. J2-732** at Trevi.
9/15/2013 16:21	9/15/2013 23:21	APL elevator released from seafloor.
9/15/2013 17:02	9/16/2013 00:02	APL elevator on board.

(GMT was 7 hours ahead of local time)

Local Time	GMT Time	Event
9/16/2013 08:47	9/16/2013 15:47	JASON on board. End J2-732 (vehicle lost power last 15 minutes before scheduled end).
9/16/2013 10:19	9/16/2013 17:19	Attached to APL buoy and begin to recover.
9/16/2013 12:55	9/16/2013 19:55	APL mooring on board.
9/16/2013 13:35	9/16/2013 20:35	CTD V13A-04 / TN300-004-01 (45°56.005'N 130°0.820'W) ASHES.
9/16/2013 15:50	9/16/2013 22:50	CTD V13A-05 / TN300-005-01 (45°56.770'N 129°59.022'W) Trevi.
9/16/2013 18:13	9/17/2013 01:13	CTD V13A-06 / TN300-006-01 (45°59.341'N 130°1.639'W) CASM.
9/16/2013 19:53	9/17/2013 02:53	EM302 Start logging.
9/16/2013 19:58	9/17/2013 02:58	EM302 Start Survey.
9/17/2013 08:20	9/17/2013 15:20	EM302 End Survey.
9/17/2013 10:47	9/17/2013 17:47	EM302 End logging.
9/18/2013 11:27	9/18/2013 18:27	Arrived at dock in Victoria, BC.
9/18/2013 19:49	9/19/2013 02:49	Departed Victoria, BC.
9/19/2013 11:00	9/19/2013 18:00	Arrived University of Washington pier, Seattle.

4 - Discipline Summaries

4.1 Geology/Geophysics

4.1.1 - Pressure Measurements to Monitor Volcanic Inflation and Deflation at Axial Seamount

Scott Nooner and Bill Chadwick

We have made ROV-based pressure measurements at Axial Seamount since 2000 to monitor vertical movements of the seafloor due to volcanic inflation and deflation caused by magma movements beneath the volcano. This year's operations included the following:

1) We deployed three Bottom Pressure Recorder (BPR) instrument moorings. Two of the BPRs (Center and South1) were the same instruments that were recovered for us in mid-August on the previous R/V Thompson cruise by John Delaney so they could be brought back to Seattle for servicing. The third BPR (South2) is a new one to replace one lost during the 2011 eruption. The BPR locations, all acoustically surveyed, are listed below.

Table 4.1.1-1 BPR Deployment Locations:

Name	Lat Deg	Lat Min	Lon Deg	Lon Min	Lat	Lon	Depth
BPR-Center	45	57.407	-130	0.636	45.95678	-130.01060	1541
BPR-South1	45	55.909	-129	59.926	45.93181	-129.99876	1540
BPR-South2	45	54.959	-129	59.609	45.91599	-129.99348	1540

2) We deployed six new cement benchmarks: two were replacements for ones lost during the 2011 eruption (AX-302 @ Trevi and AX-303 @ Marker 33 site), two were new locations to improve the spatial coverage of inflation monitoring (AX-307 @ Magnesia West and AX-308 @ BPR-South1), and two were deployed for University of Washington, near where there will be pressure/tilt instruments on the OOI/RSN cabled observatory (AX-309 @ RSN-PrimaryNode and AX-310 @ International District). The new benchmarks were free-falled from the surface as small moorings with a detachable

descent weight and two glass balls for counterbalance flotation with a Homer probe attached, making it easier for Jason to find them and move them on the bottom. The cement benchmarks weigh ~150 lbs in water, and with the flotation they are ~50 lbs, allowing Jason to pick them up and relocate them to stable sites. There are now a total of 10 cement benchmarks – the six new ones and four old ones. Three of the sites have both cement benchmarks and older metal benchmarks (AX-202 @ Trevi, AX-203 @ Marker 33 Site, and AX004 @ BagCity); the metal benchmarks at Trevi and M33 were used as temporary sites in 2011 for the sites buried in new lava, and were re-occupied again in 2013.

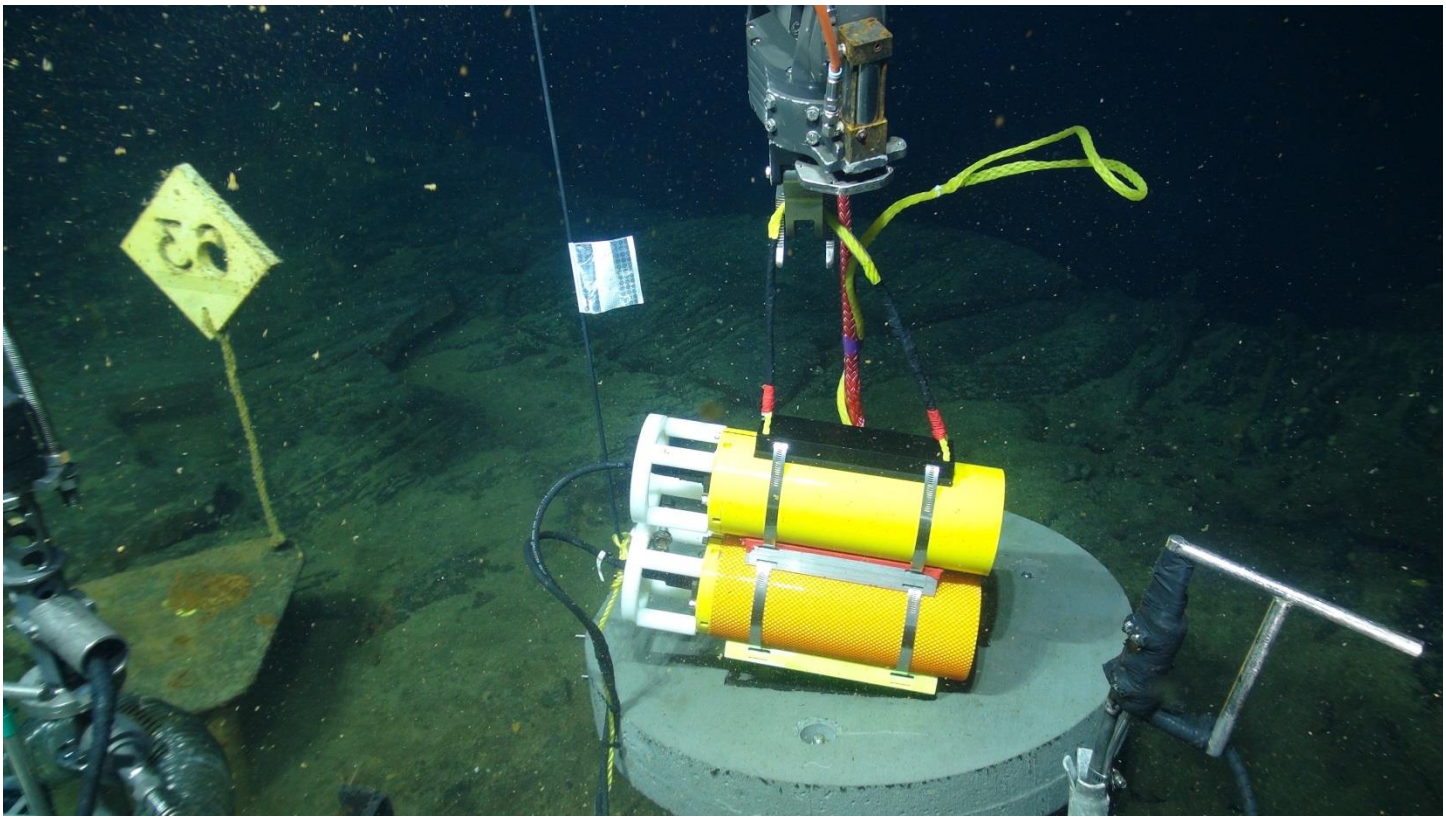


Fig. 4.1-1. Trevi site benchmarks AX-302 (with instrument being lowered) and AX-202 (with Mkr 63 attached).

Table 4.1.1-2 Cement Benchmark Locations:

AXIAL CEMENT BENCHMARK NAMES	Latitude	Longitude	Depth	LAT DEG	LAT MIN	LON DEG	LON MIN
AX-101 Caldera Center	45.95520	-130.00987	1532	45	57.3120	-130	0.5920
AX-104 Bag City	45.91617	-129.98950	1534	45	54.9700	-129	59.3700
AX-105 Pillow Mound	45.86317	-130.00376	1718	45	51.7900	-130	0.2250
AX-106 Ashes	45.93445	-130.01160	1542	45	56.0670	-130	0.6960
AX-302 Trevi	45.94642	-129.98378	1522	45	56.7850	-129	59.0270
AX-303 Marker 33 site	45.93346	-129.98225	1516	45	56.0080	-129	58.9350
AX-307 Magnesia West	45.94535	-130.00906	1544	45	56.7210	-130	0.5440
AX-308 BPR-South1	45.93160	-129.99880	1533	45	55.8960	-129	59.9280
AX-309 RSN-PN	45.93835	-129.97208	1527	45	56.3010	-129	58.3250
AX-310 International District	45.92580	-129.97787	1531	45	55.5480	-129	58.6720

3) Pressure was measured at all the new benchmarks during Jason dive J2-730, which lasted almost 5 days. Each measurement was made by placing an MPR (mobile pressure recorder) on top of a benchmark and recording for 20 minutes. Data were recorded in a laptop PC in the Jason control room. This year we had two MPRs instead of our usual one; the two MPRs were attached together, one on top of the other. The two Paros pressure gauges that we have used in the past (s/n 43535 and 62201) were repackaged by Glenn Sasagawa at Scripps into a new pressure case this year. The second MPR was also built by Scripps for the OOI/RSN and is nearly identical (with new Paros gauges s/n 122882 and 122883). As in the past, benchmark AX-105 was used as the reference site and assumed to be stable, and the depths of the other benchmarks were determined relative to the reference site. The survey consisted of two round trip transects from the caldera to the reference site and back in the following order (with the number of occupations at each site in parentheses): AX-308 (3), 106 (4), 307 (4), 101 (4), 202/302 (4), 309 (4), 203/303 (4), 310 (4), 104 (4), 105 (2). The total distance traversed during the dive was 65 km. The Jason navigation was excellent making finding the benchmarks on the bottom very efficient. We conducted some fluid sampling for Dave Butterfield on the final transect. The average transit speed for towing Jason from benchmark to benchmark was about 1 knot.

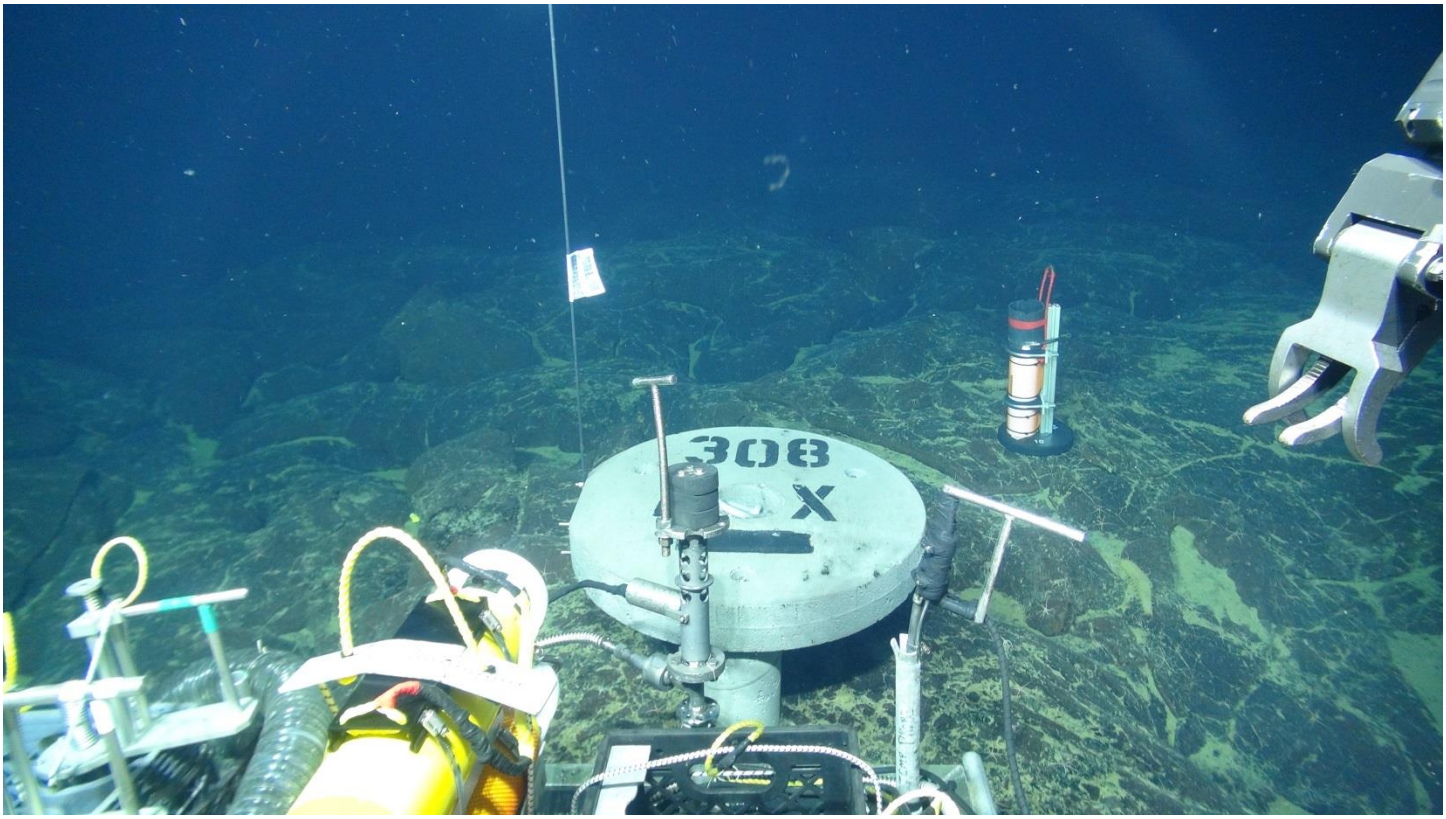


Fig. 4.1-2 2013 deployed AX-308 benchmark at the BPR-South1 location. A mini-BPR was deployed uring this cruise adjacent to the permanent benchmark for calibration purposes. It was recovered at the end of the 5-day pressure dive (J2-730).

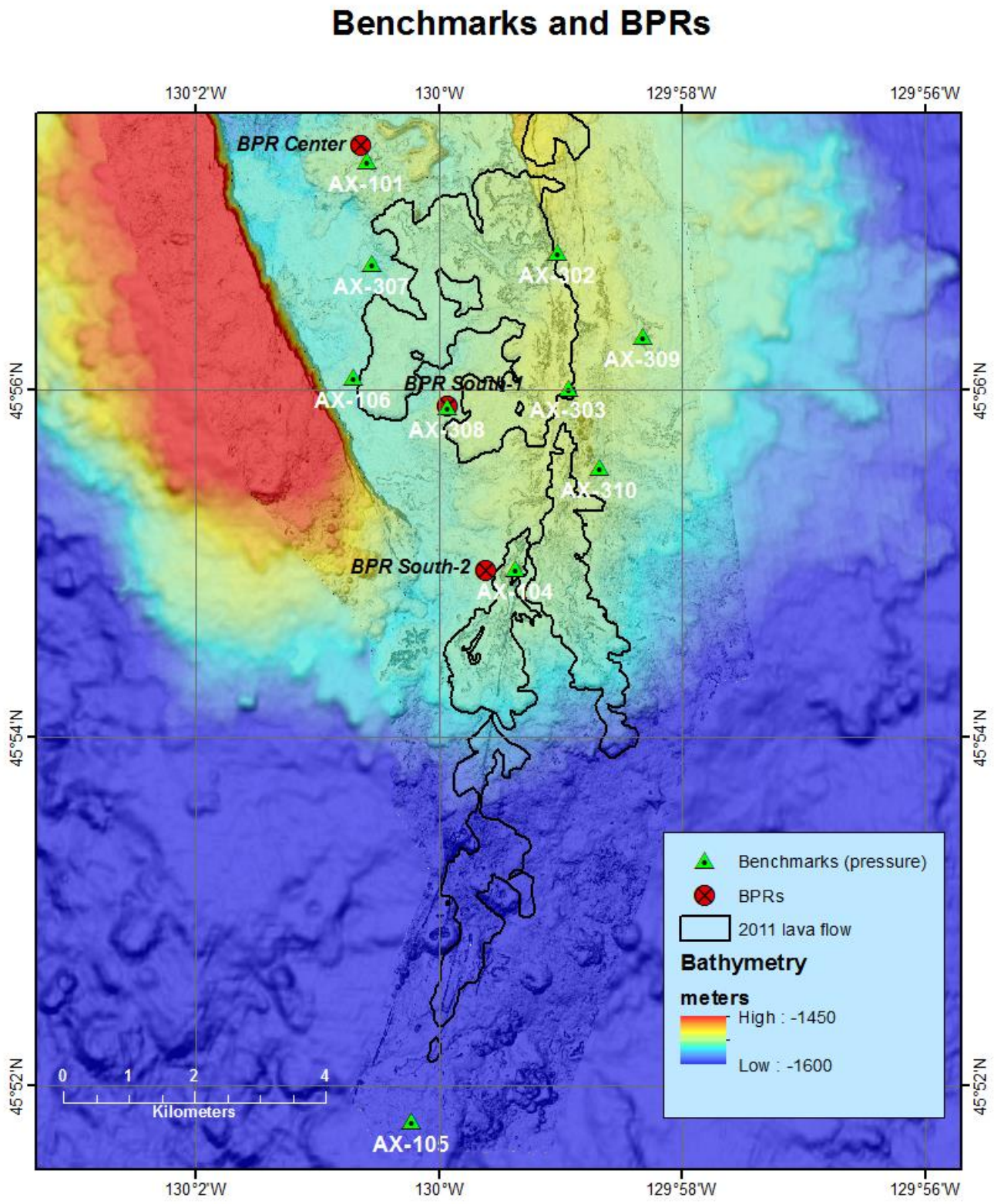
The pressure data were converted to depth then corrected for ocean tides using data collected by an autonomous tide gauge (kindly supplied by Glenn Sasagawa) that Jason deployed near AX-308 at the beginning of the dive and recovered at the end. In addition, instrument drift was calculated during the survey and was removed. The uncertainty in the pressure measurements was determined by the scatter of repeated measurements at each benchmark and was ± 0.6 cm this year, matching our previous best results. Comparing the benchmark depths in 2013 to our previous survey in 2011 shows the following depth changes (all uplift from 2011-2013).

Table 4.1.1-3 Depth changes from 2011 to 2013.

BENCHMARK NAME	Depth change (m)
AX-101 Caldera Center	1.223
AX-104 Bag City	0.516
AX-105 Pillow Mound	0.000
AX-106 Ashes	0.805
AX-202 Trevi	0.607
AX-203 Marker 33 site	0.567

The data from the MPR survey and the BPRs that were recovered suggest to us the following: The post-2011 eruption inflation rate has been higher than we expected to see. We measured 1.22 m of uplift since August 2011, totaling 1.57 m of reinflation since the April 2011 eruption. This is an average uplift rate of 61 cm/yr! For comparison, during most of the period between the 1998 and 2011 eruptions, we saw steady inflation at only 15 cm/yr, but it is possible that we missed this rapid re-inflation phase during a 2-year gap in monitoring after the 1998 eruption. In addition, we expected to see a gradually decreasing rate of uplift since 2011. Instead, there was an almost a doubling in the inflation rate in September 2012, recorded on both of the BPRs that were in place during 2011-2013. Overall, this means that Axial has already recovered 65% of the -2.4 m of deflation that we measured during the 2011 eruption. If this high inflation rate continues, Axial will be back to its pre-2011 level of inflation within only another year and a half (by January 2015)! On the other hand, if the rate of inflation slows down to rates more like we saw between 1998-2011, then the pre-2011 level of inflation will not be reached until ~2018 (more-or-less as depicted in Figure 3a of our 2012 Nature Geoscience paper). We don't really know what this means in terms of forecasting the next eruption, but an inescapable conclusion is that the inflation rate since 2011 has been higher than we've ever measured, and this may imply that the next eruption could come sooner rather than later. These results show that it is important to keep this time-series going, because it is still providing new insights and surprises, it will allow us to document the post-eruption reinflation phase for the first time, and it will provide invaluable context for the OOI/RSN observatory. This work was funded by the National Science Foundation.

Fig. 4.1.1-1. Map of the benchmark (pressure measurement locations) and the BPRs (bottom-pressure-recorders) at Axial.



4.1.2 Self-Calibrating Pressure Recorder

Glenn Sasagawa, Scripps Institution of Oceanography

The UCSD Gravity lab deployed a Self-calibrating Pressure Recorder (SCPR), unit 001, at the Ashes site near AX-103. The SCPR deployment began at 08 Sept 2013, 1600L using the trawl wire. The vessel was initially positioned 250m south of the deployment location. A JASON USBL transponder was temporarily added to the SCPR frame. Starting at 1632L, the SCPR was lowered into the water. Wire was paid out at 20 m/min to 30m wire out, then wire was paid out at 40m/minute to 1400m wire out. The wire was allowed to swing back under the ship; after this was done, the wire was paid out to 1470m. At 1817L, the mooring was released and the touchdown was monitored on the USBL navigation screen in the Jason control van.

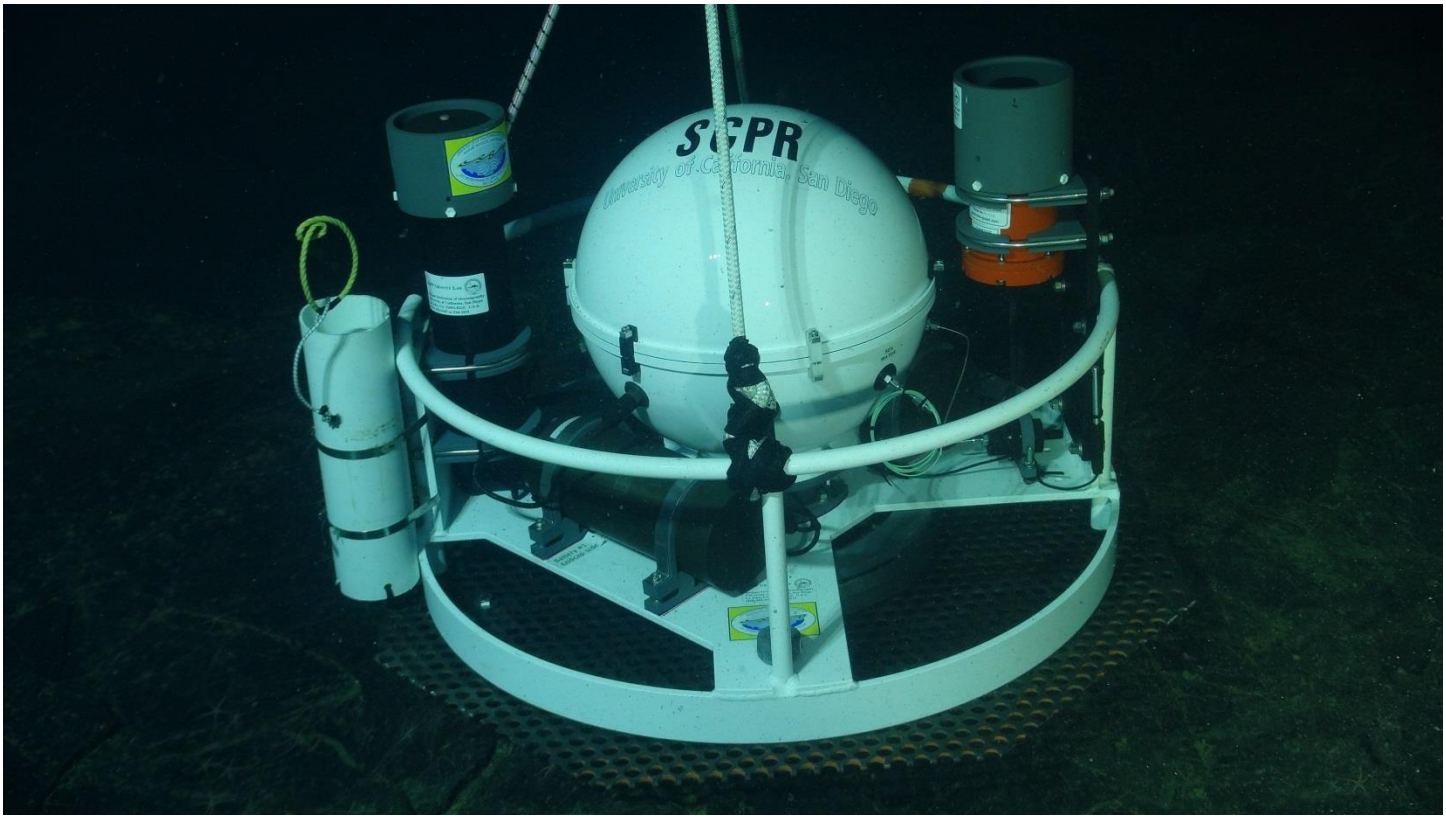


Fig. 4.1.2-1. The SCPR in its final position near ASHES vent field and the pressure benchmark AX-103.

During Jason dive J2-729, the planned work was completed early and the ROV made its way to the SCPR mooring. Mooring was in sight at 09 Sept 2013 1340 UT (0640L). At 1350 UT, communications were established with the SCPR computer. The initial level was out of gimbal range, so the SCPR package was relocated to **45º 56.0626´ N, -130º 0.7069´ E, depth 1541 meters**. At 1419 UT, the repositioning was complete and appeared acceptable. The USBL transponder was recovered to the ROV. A calibration was initiated and appeared to proceed normally. Communications were lost when the ROV was repositioned during the calibration; the Linkquest modem was shadowed by the ROV floatation. Communications were re-established and a normal end of calibration and shutdown was observed.

Additional communications was established during the pressure dive (J2-730), when opportunity allowed. Communications and downloads were obtained on 10 September and 12 September. The SCPR was found to be operating normally. The planned deployment duration is two years, with a hoped-for data offload in 2014.

4.2 Fluid Sampling

4.2.1 2013 Hydrothermal Fluid Chemistry Summary

David Butterfield
University of Washington, Joint Institute for the Study of the Atmosphere and Ocean

Axial 2013 Summary

The NeMO project continued for the 15th consecutive year. The primary goals of our 2013 NeMO program were to collect time-series samples from Axial Seamount as part of a long-term study of the hydrothermal system over an entire eruptive cycle, and to collect samples for detailed microbiological experiments. We had 3 full Jason ROV dives for the NeMO project to sample vents for chemistry and microbiology and recover and deploy temperature sensors. No RAS sampler was deployed at Axial in 2012, so there was no time-series instrument to recover in 2013. A RAS time-series chemistry sampler was installed at El Gordo vent in the International District vent field. We were able to collect samples from additional sites during Bill Chadwick and Scott Nooner's 5-day-long dive for geodetic measurements. Personnel involved in the chemistry/microbiology portion of the Thompson/Jason cruise included Dave Butterfield, Kevin Roe, Ben Larson, Leigh Evans, Chris Algar, James Holden, Caroline Fortunato and Begum Topcuoglu. Funding for the ship and ROV time for NeMO 2013 was provided by NOAA and ONR (through collaboration with Dave Dyer of the UW Applied Physics lab). Science funding for chemistry and microbiology was provided by PMEL and the Gordon and Betty Moore Foundation, Marine Microbiology Initiative.

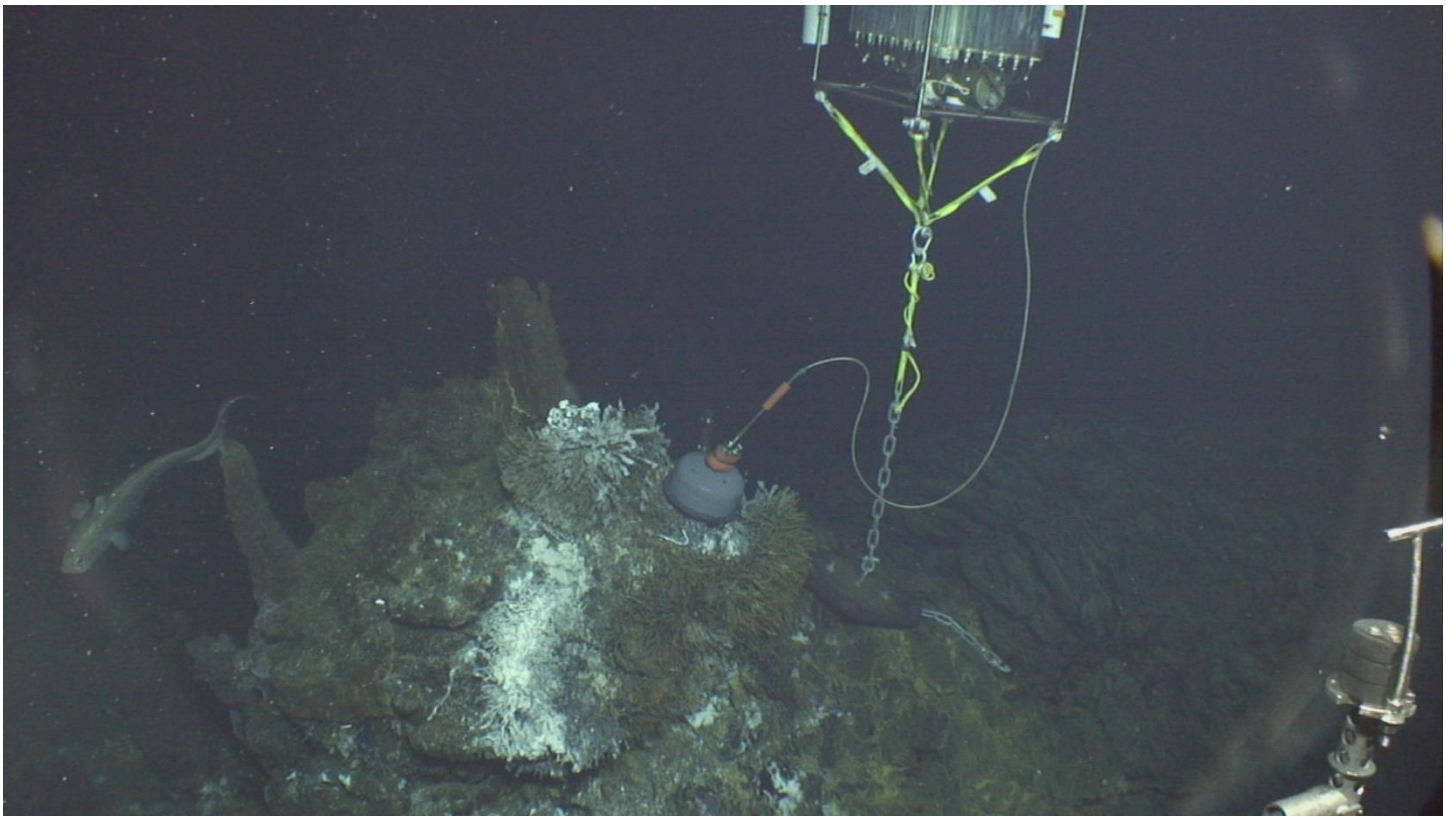


Fig. 4.2-1 RAS chemistry sampler installed at El Gorda vent in the International District vent field on dive J2-728.

We collected 57 samples for fluid chemistry using HFPS and titanium major samplers plus 20 samples with titanium gas-tight samplers during the Thompson/Jason cruise. The Sample Split Summary Table describes how the samples were processed and divided. The samples represent many of the known high-temperature sites (ASHES, International District, Casper/Vixen, and Trevi) and many of the known diffuse sites. We took the first fluid samples from the 'Dependable' vent field located on the SE flank of Axial Seamount at approximately 1940 m depth. This field was discovered by the RSN group during a cable survey dive when it was found that the primary fiber-optic cable had been placed directly in a high-

temperature vent. The appearance of the vents in this field is distinct from all of the vents within the caldera, with horizontally-growing flanges dominating the vent structures at Dependable. We collected an active sulfide flange mineral sample and a large piece of sulfide talus.

Falkor/ROPOS Summary

2013 marks the first research cruise dedicated to the Moore MMI project. The key microbiology and chemistry personnel were on board the Falkor to sample hydrothermal fluids with the ROV ROPOS. Due to the extremely bad weather during most of the cruise, we completed only two full HFPS dives. The focus was on a small number of diffuse vent sites to collect sufficient volume of fluids to do a wide range of microbiological experiments and to characterize fully the chemistry of the target sites. We sampled the high-priority vent sites Marker 113, Skadi, Marker 33 and Boca with HFPS. In addition to these 4 target sites, the IGT samplers and the large volume water sampler for virus work were used at Anemone and a near-caldera background site. Anemone vent was sampled with HFPS during the Thompson/Jason cruise earlier in September. A total of 23 fluid samples were collected with HFPS, along with 10 IGT samples and 7 RNA filters. The research cruise with ROV ROPOS on the Falkor was funded by the Moore Foundation and the Schmidt Ocean Institute.

HFPS Configuration

Because the configuration of HFPS changes slightly with time, we provide some details of how it was set up. Valve position 1 was the large volume bag (4-liter) used for microbiology experiments on board (Stable Isotope Probing, or SIP). Valve positions 2 through 9 were occupied by pistons. Pistons 2-5 were titanium with Teflon end caps. Pistons 6-9 were PVC. Even-numbered positions were filtered through Millipore http 0.4 micron polycarbonate membrane filters. Positions 10, 11, and 14-16 were 47mm diameter, 0.2micron pore size, flat membrane filters in McClane filter holders with preservative reservoirs filled with RNA-Later preservative. The preservative was passively added to the filter in-situ after the sample was taken. Positions 17-24 were collapsible Tedlar bag samples. The even-numbered bags were filtered through 0.4 micron membrane filters, with the exception that bag 18 was not filtered during the Falkor/ROPOS dives in order to provide more unfiltered water for microbiological experiments. Bag 17 was set up with an acid-cleaned Teflon sample bag for gold analysis and processed specifically for gold. Samplers with all Teflon and titanium parts were preferred for the hottest samples. We collected a number of replicates of hot water samples with HFS pistons and titanium major samplers during the Thompson cruise to evaluate sampling equipment artifacts that cannot be easily determined from laboratory experiments. During the Thompson cruise, we connected 3 UCSB-type gas-tight samplers to the HFPS manifold, and also used 3 additional gas-tight samplers in discrete mode and triggered by a hydraulic ram on Jason's manipulator. The number of gas-tight samplers on the ROV varied depending on payload issues. Through both cruises, the standard HFPS intake nozzle was used without any additional attachment/adapter. Giora Proskurowski's IGT samplers (2 per dive) were used instead of the UCSB-type during the Falkor/ROPOS dives.

Chemical Sensors on HFPS. Positions 12 and 13 were dedicated to chemical sensors. A new Seabird (Bellvue, WA) 63 Optical Oxygen sensor was plumbed in series with a AMT (Rostock, Germany) deep-sea glass pH electrode. Both sensors responded consistently. The oxygen sensor produced water column profiles that were very close to the dual Seabird 43 Clark-type electrochemical oxygen sensors mounted on the Thompson CTD. There was no CTD deployment during the Falkor cruise, and we have not yet evaluated the oxygen data recorded by ROPOS. The oxygen sensor on HFPS appeared to continue to work normally throughout the Falkor cruise. We did not fully evaluate the pH data from the AMT sensor during the cruises, but it appeared to respond normally throughout both cruises. Calibration of the AMT pH sensor before and after the Jason cruise was linear and very close to the calibration done by AMT. We will perform a post-Falkor cruise calibration. Two hydrogen sulfide sensors were refurbished and calibrated by AMT before the research cruises. The first sensor failed completely at a depth of approximately 1200 meters on the first deployment, and the second sensor failed in water less than 100 m deep at the beginning of the second Jason dive with HFPS. We need to find an alternative H2S sensor.

Sample Processing and Analysis

Kevin Roe analyzed hydrogen sulfide, dissolved silica and ammonia on board by spectrophotometry. Dave Butterfield (and Chris Algar on the Thompson cruise) analyzed pH and alkalinity. Ben Larson analyzed methane and hydrogen on Butterfield's SRI gas chromatograph during the Thompson cruise, and Giora Proskurowski and Ben Larson analyzed hydrogen and methane on Proskurowski's HP gas chromatograph on the Falkor cruise. Leigh Evans processed gas-tight samplers (UCSB-type) during the Thompson cruise. We processed nearly all of the HFPS samples for gas analysis. If a gas headspace was present, the entire gas volume was removed and combined into a gas sample bag, the volume of the gas was measured at room T and P, and the methane and hydrogen content of the gas was analyzed on the GC. Immediately after the gas removal (within 1 minute), a liquid sample was taken and the gas content of the liquid was also analyzed. The total sample volume of the liquid was determined by weight, by piston displacement, or by tally of all the sub-sample volumes. The measurements are combined to calculate the total methane and hydrogen content of the fluid. In many cases, we have UCSB or IGT gas-tight samples for comparison.

UCSB Gastight bottle contents were divided into three sub-samples during seaboard processing, degassed liquids and two sizes of glass ampule. Magnesium concentration will be analyzed in the liquid and gases will be analyzed from the contents of glass ampules. Aluiminosilicatae ampules of an approximate volume of 3 ml will be dedicated to the stable isotopes of helium in John Lupton's lab in Newport. Pyrex ampules of an approximate volume of 35 ml will be used to measure hydrogen, methane, carbon dioxide and some atmospheric gases in Marv Lilley's lab in Seattle.

Our shore-based analytical plan is similar to previous years. We will analyze major elements (Na, K, Mg, Ca, Cl, SO4) by ion chromatography, minor elements (Li, F, B, Sr, Rb, Fe, Mn) by Atomic Absorption, ICP-OES, ion-selective electrode, and other techniques, a suite of trace metals (Fe, Mn, Cu, Zn, Pb, Mo, Ni, Ag, Cd, Bi, U and others) by ICP-MS, S isotopes on H_2S and SO_4 by mass spectrometry in collaboration with ETH-Zurich, O and H isotopes of water at UW, stable C on DIC (Giora), Sr and Pb isotopes on selected samples. Sub-samples of unfiltered, low-temperature vent fluids were saved for cell counts. Sub-samples of a few samples were saved for virus counts on the Falkor cruise. Nutrient samples (filtered and purged with nitrogen, but not acidified per discussion with Annie Bourbonnais) were frozen and will be sent to Annie Bourbonnais for both nutrient analysis and isotopes of N and O on nitrate. Replicate nutrient samples (filtered, acidified, and purged with nitrogen) were saved and frozen to be analyzed for nutrients (by either the PMEL nutrient lab or the UW nutrient lab). Samples for analysis of N isotopes on nitrite were preserved with NaOH solution and frozen, to be analyzed by Annie Bourbonnais. DOC will be analyzed on selected samples from each vent site. A subset of samples collected by Jason were saved for both total DIC and stable C isotopes on DIC to be analyzed by Giora Proskurowski. Only the IGT samples (not HFPS samples) from the ROPOS dives were saved for DIC and stable C on DIC.

Table 4.2-1 Hydrothermal Fluid Sample Metadata

DB Sample#	Vent	Date	Start Time	Stop Time	Tmax °C	Tavg °C	Pump Volume	Best Volume
J2-726BF24	**Near Casper**	9/5/2009	1:47	1:51	26.6	26	651	607
J2-726BF22	**Near Casper**	9/5/2009	1:53	1:56	26.2	26	651	603
J2-726BF18	**Near Vixen**	9/5/2009	2:29	2:34	34.1	33.9	602	532
J2-726B19	**Near Vixen**	9/5/2009	2:35	2:38	34.2	34	601	614
J2-726PF2	**Vixen**	9/5/2009	3:39	3:41	333.3	319.3	400	316
J2-726P3	**Vixen**	9/5/2009	3:41	3:44	333.6	330.8	401	544
J2-726B17	**Vixen**	9/5/2009	3:53	3:54	334.9	319.9	304	304
J2-726PF4	**Casper**	9/5/2009	5:25	5:28	249.8	247	402	465
J2-726P5	**Casper**	9/5/2009	5:30	5:32	252.9	241	402	383
J2-726PF8	**Virgin**	9/5/2009	8:26	8:33	265.2	265.1	411	316
J2-726P9	**Virgin**	9/5/2009	8:36	8:40	nd		401	0
J2-726LVB1	**Anemone**	9/5/2009	10:08	10:29	30.6	28.5	4003	4003
J2-726BF20	**Anemone**	9/5/2009	10:31	10:34	29.1	28.2	651	614
J2-726B21	**Anemone**	9/5/2009	10:36	10:39	30.9	29.2	651	667
J2-726B23	**Anemone**	9/5/2009	10:41	10:50	35.9	34.3	663	346
J2-726PF6	**Inferno**	9/5/2009	12:16	12:20	300.1	299.6	600	502
J2-726P7	**Inferno**	9/5/2009	12:20	12:27	300.3	300	657	662
J2-726MW	**Inferno**	9/5/2009	12:37		311.3			750
J2-726MY	**Inferno**	9/5/2009	12:56		311.3			750
J2-728BF18	**Marker 151**	9/7/2009	5:40	5:44	62.9	61.3	610	542
J2-728B19	**Marker 151**	9/7/2009	7:46	7:48	59.1	58.8	629	0
J2-728BF22	**Escargot diffuse**	9/7/2009	8:29	8:32	6.6	6.5	627	608
J2-728BF24	**Escargot diffuse**	9/7/2009	8:34	8:37	6.5	6.4	626	600
J2-728PF8	**Escargot**	9/7/2009	9:21	9:23	264.1	262.2	503	505
J2-728P9	**Escargot**	9/7/2009	9:24	9:27	265.7	263.1	501	485
J2-728PF2	**Diva**	9/7/2009	9:54	9:55	271.5	271.2	201	206
J2-728BF20	**El Guapo diffuse**	9/7/2009	11:36	11:39	24.9	23.8	626	605
J2-728B21	**El Guapo diffuse**	9/7/2009	11:41	11:43	24.9	23.8	629	632
J2-728B23	**El Guapo diffuse**	9/7/2009	11:45	11:48	25.7	25.2	629	430
J2-728LVB1	**El Guapo diffuse**	9/7/2009	11:53	12:10	26.1	24.2	4002	4200
J2-728PF4	**El Guapo top**	9/7/2009	13:22	13:24	338.1	332	455	493
J2-728P5	**El Guapo top**	9/7/2009	13:26	13:28	339.2	326.4	451	464
J2-728MW	**El Guapo top**	9/7/2009	13:45		342			750
J2-728MY	**El Guapo top**	9/7/2009	13:49		342			750
J2-728B17GOLD	**El Guapo top**	9/7/2009	13:57	13:59	334	307	401	450
J2-728PF6	**El Guapo midway**	9/7/2009	14:25	14:28	63.3	58	600	742

DB Sample#	Vent	Date	Start Time	Stop Time	Tmax °C	Tavg °C	Pump Volume	Best Volume
J2-728P7	**El Guapo midway**	9/7/2009	14:29	14:32	56.1	54.1	600	612
J2-728P3	**Castle**	9/7/2009	15:22		271.6	266	253	292
J2-730B17	**Bag City**	9/11/2009	01:54:31	01:57:30	19.7	19.5		563
J2-730BF18	**Bag City**	9/11/2009	02:22:45	02:25:29	19.9	19.6		505
J2-730P7	**N3**	9/12/2009	04:19:40	04:23:01	20.1	19.5		671
J2-730B19	**N3**	9/12/2009	09:01:58	09:04:48	19.6	19.1		582
J2-730BF20	**N3**	9/12/2009	09:05:51	09:08:41	18.9	17.5		505
J2-730LVB1	**N3 LVB**	9/12/2009	09:09:56	09:26:50	20.1	19.6		
J2-730B21	**N3**	9/12/2009	14:16:52	14:19:47	19.8	19.7		537
J2-730P9	**Spanish Steps**	9/13/2009	01:58:45	02:02:42	24.5	22.6		662
J2-730PF8	**Spanish Steps**	9/13/2009	04:12:58	04:15:59	20	17.8		709
J2-730PF2	**Trevi**	9/13/2009	05:34:53	05:37:49	250.4	250		400
J2-730P3	**Trevi**	9/13/2009	05:38:39	05:41:22	250.2	250		396
J2-730PF4	**Trevi**	9/13/2009	06:26:49	06:29:30	250.2	249.9		421
J2-730B23	**Bckgnd SW**	9/11/2009	05:44:59	05:47:41	2.5	2.4		583
J2-731B18	**Diffuser w worms**	9/14/2009	01:54:31	01:57:30	26	?	630	606
J2-731B19	**Diffuser w worms**	9/14/2009	02:22:45	02:25:29	23.7	22.8	629	592
J2-731PF2	**Above Mkr 142**	9/14/2009	05:34:53	05:37:49	150.4	143.1	601	605
J2-731P3	**Above Mkr 142**	9/14/2009	05:38:39	05:41:22	141.8	140.2	629	641
J2-731PF4	**Trusty**	9/14/2009	06:26:49	06:29:30	183.8	175.7	601	626
J2-731B21	**Near broken chimney**	9/14/2009	09:05:51	09:08:41	49.2	48	653	659
J2-731B23	**background SW**	9/14/2009	14:16:52	14:19:47	2.8	2.7	626	596
J2-731-LVB1	Near broken chimney	9/14/2009	9:09:59	9:27:30	50	48.8	4002	4200

Table 4.2-2 Hydrothermal Fluid Sample Processing

DB Sample#	gas head vol	gas H2O	H2S/Si	pH/ alk	Majors	Trace Metal	Nutrient	N isotope	Microbio	Total DIC	13C-DIC	Sulfur isotopes	O/H isotopes	DOC
custody->	DB	DB	DB	DB	DB	DB	AB	AB	JH/CF	GP	GP	DB/GFG	DB	DB
J2-726BF24	0	7	25	35	45	250	35	45		10	10	45		100
J2-726BF22	0	12	25	35	35	236	45 din103	45 bno2#106		11	11	45		100
J2-726BF18	0.5	7	30	35	35	250	45 din125	45 bno2#101		11	11	45		
J2-726B19	0	7	30	35	35	210	45 din116	45 bno2#183	140	10	10	24	12	
J2-726PF2	87	3	25	35	35	123	45 din108	35 bno2#151					10	
J2-726P3	215	7	15	38	35	176	50 din122	50 bno2#103		10	10	45	5	
J2-726B17	approx 200		gold analysis		35	400								
J2-726PF4	55*	28	18	35	35	214	45 din114	45 bno2#179				45		
J2-726P5	77	6	20	35	35	207	40 din107	40 bno2#125						
J2-726PF8	336*	6	35	35	35	108	35 + 48 din109	30 bno2#178		10	10			
J2-726P9	FAILED	NO SAMPLE		x	NO SAMPLE									
J2-726LVB1					8					10	10			
J2-726BF20	0	7	25	35	35	244	45 din120	45 bno2#168		10	10	24x2		100
J2-726B21	0	6	15	x	x	30			620					
J2-726B23	0	7	20	35	35	134	45 din112	no	40	10	10			
J2-726PF6	0	7	20	35	35	250	45 din129	45 bno2#193		10	10	45		
J2-726P7	65	12	20	35	35	450	45 din104	45 bno2#105		10	10			
J2-726MW	?	0		35	35	500	45							
J2-726MY	?	0		35	35	500	40 din132	20					15	
J2-728BF18	260	12	25	35	35	250	45 din#178	45 bno2#157						100
J2-728B19	19	NO SAMPLE		NO SAMPLE										
J2-728BF22	0	12	40	35	35	318	45 din195	45 bno2#133		11	11	45		
J2-728BF24	0	12	35	35	35	282	45 din139	45 bno2#153						100
J2-728PF8	1564	8	16	35	35	253	44 din102	44 bno2#152		10	10	45		
J2-728P9	?	8	18	35	35	259+25	45 din134	45 bno2#176					15	
J2-728PF2	1600	7	20	35	35	107								
J2-728BF20	0	20	30	35	35	250	45 din188	45 bno2#129		11	11		15	110
J2-728B21	0	5	microcosm experiment						627					
J2-728B23	0	10	30	36	35	156	45 din142	45 bno2#112	40	10	10			
J2-728LVB1	?	5			60									

DB Sample#	gas head vol	gas H2O	H2S/Si	pH/ alk	Majors	Trace Metal	Nutrient	N isotope	Microbio	Total DIC	13C-DIC	Sulfur isotopes	O/H isotopes	DOC
custody->	DB	DB	DB	DB	DB	DB	AB	AB	JH/CF	GP	GP	DB/GFG	DB	DB
J2-728PF4	64	16	18	35	35	263	45 din#130			11	11	45	12	
J2-728P5	370	12	20	35	35	267	45 din#131	45 bno2#174						
J2-728MW	?	0	30	35	35	500								
J2-728MY	?	0	30	35	35	500								
J2-728B17GOLD	>200ml				35?	450								
J2-728PF6	0.5	10	29	35	35	378	45 din#117	45 bno2#171		10	10	45		100
J2-728P7	0	20	30	35	35	395	45 din#113	45 bno2#116		11				
J2-728P3	705	7	20	35	35	105	45 din#127	35 BNO2#142						
J2-730B17	0	20	40	35	35	166	45 #141	45 #167	40	no	no			94
J2-730BF18	0	20	40	35	35	123	40 #177	45 #131		10	10	45		100
J2-730P7	95	15	30	35	35	?	45 #155	40#135	40	10	10			
J2-730B19	>145		microcosm		10				572					
J2-730BF20	40	15	35	35	35	140	45 #123	40 #140		10	10	45		95
J2-730LVB1														
J2-730B21	258	40	39	35	35	206	45 din144	40 bno2#126		10	11			100
J2-730P9	15	14	35	36	35	398	45 #159	45 #121	40	10	10			
J2-730PF8	0	11	35	35	35	343	45 din110	45 bno2143		10	10	45		95
J2-730PF2	30	15	15	35	35	300		leaking past piston - sample no good						
J2-730P3	225	30	17	35	35	178	45 #135	45 #187			11		no	no
J2-730PF4	190	12	15	35	36	160	45 #160	40#162				45		
J2-730B23	0	20	35	35	35	152	45 #126	43 #107	40	10	11	45	10	100
J2-731B18	0	15	35	35	35	296	45 #162	45 #124						100
J2-731B19	0	15	30	35	35	271	45 #169	45 #115	40	15	10	45		
J2-731PF2	0	15	35	35	35	314	45 #170	45 #182		11	15	45	15	
J2-731P3	0	15	35	35	35	437	45 #133					45		
J2-731PF4	10	23	35	35	35	325	45 #148	45 #108		13	11	45	10	
J2-731B21	2	15	30	35	35	353	45 #161	45 #158	40	10	10			
J2-731B23	0	25	40	35	35	200	45 #137	45 #154	40					100
J2-731-LVB1		10	25		10				4000					

Sample split volumes in mL.

Nutrient and NO2 isotope numbers refer to Annie Bourbonnais bottle label numbers.

Custody indicates whose lab will analyze each sample split: DB=Butterfield; AB=Annie Bourbonnais; GP=Giora Proskurowski; JH=Jim Holden; CF=Caroline Fortunato(Huber lab); GFG=Gretchen Fruh-Green.

4.2.2 RNA-SIP-Genomics Analysis

Julie Huber Laboratory Sampling

Caroline Fortunato / Chris Algar – Marine Biological Laboratory

For each Hydrothermal Fluid and Particle Sampler (HFPS) dive the following was performed:

Collection of RNA for Metatranscriptomics:

Five filter holders charged with RNAlater and containing a 0.2um flat filter were loaded onto the HFPS. At each vent site, 3L was pumped through each filter and flooded with RNA later. Once on deck, filters were removed from their holders, folded into quarters and placed into sterile 50mL tubes with ~15mL of RNA later. Tubes were kept at 4ºC for 24 hours and then moved to -80ºC.

Stable Isotope Probing (SIP) experiments:

On each HFPS dive, 4L of vent fluid was collected using a large volume bag (LVB). This fluid was used to fill six evacuated 500mL bottles. Water was pumped from the LVB into each bottle using a peristaltic pump and needle. Before filling, each bottle was spiked with either 13C or 12C labeled sodium bicarbonate to a final concentration of 10uM. Bottles were filled to 530ml and incubated at 30ºC, 55ºC, 80ºC, with two bottles at each temperature, a labeled experiment (13C) and an unlabeled control (12C). Bottles were incubated for 36 hours. Once the 36 hour incubation was complete, bottles were filtered through 0.22um Sterivex filters, preserved with RNA later, and frozen at -80ºC. SIP experiments were completed at Anemone, El Guapo, N3 Area, and Dependable vents.

Single Cell Genomics:

From the LVB, 1ml of water was added to a sterile cryovial with 100ul of filter-sterilized GlyTE. Vials were then inverted for mixing and incubated at room temperature for 5min before being frozen at -80ºC. Triplicate samples were taken.

4.3 Microbiology

Thermophilic Biogeochemical Processes

Jim Holden / Begum Topcuoglu, University of Massachusetts (Amherst)

The goal of our research is to model the habitability of hydrothermal vent environments by thermophilic and hyperthermophilic anaerobic microorganisms and the biogeochemical impact of these organisms on the deep sea. On this cruise, we determined the concentrations of cultivatable methanogens, autotrophic sulfur reducers, autotrophic iron reducers, and anaerobic heterotrophs that grow at 55 and 80°C, and determined the potential growth restraints (e.g., N availability, H_2 concentration, trace metal or vitamins) on natural assemblages of methanogens at the same temperatures. Low-temperature (< 30°C) hydrothermal fluid samples were collected using the hydrothermal fluid sampler and processed from vents at Anemone (J726-unfiltered bag 21), Vixen (J726-unfiltered bag 19), El Guapo (J728-unfiltered bag 21), and Marker N3 (J730-unfiltered bag 19). From each bag (~640 ml per bag), except the Vixen sample, 400 ml were used for methanogen microcosm incubations, 100 ml were used for three-tube most-probable-number estimates, 18 ml were preserved in 3-4% formaldehyde for total cell counts, and 5 ml and the remaining fluid were filtered onto a 0.2 µm pore size membrane filter and preserved with 4% paraformaldehyde for fluorescence in situ hybridization (FISH) counts of specific cell types. For the Vixen sample, only MPN incubations were run and total cells were preserved. We also filtered and preserved 5 ml, 25 ml, 50 ml, and 100 ml of fluid for FISH analysis from each of the two large volume bags (R1663-01 and R1665-01) collected for SIP experiments by the Huber lab, and preserved 40 ml of fluid from each low-temperature unfiltered hydrothermal fluid sample collected for total cell counts. Final results cannot be determined at sea, but there are very good indications that we had growth of methanogens in our microcosm and MPN experiments at 55 and 80°C and in our heterotroph MPNs at the same temperatures.

Fig. 4.3-1 Jim Holden / Begum Topcuoglu preparing samples for analysis in the Thompson's biology laboratory.

4.4 Pharmacology

Oliver Vining, Oregon State University

The focus of our research is to identify and characterize biologically active small molecules as leads for the treatment of human diseases. We are investigating deep-sea hydrothermal vents based on the observation that chemical diversity often correlates with biological diversity, and thus phylogenetically unique organisms from rare or extreme ecosystems are rational sources of novel chemotypes with important biological activities.

For this cruise our group had three main collection goals. The first was to collect sediment samples from ambient and warm temperature (< 25°C) sites adjacent to diffuse venting as part of our effort to cultivate bacteria with high potential for the biosynthesis of biologically active metabolites, particularly members of the Actinomycetales. To this end we used syringe samplers to collection ten sediment and bacterial mat samples, which were stored in both a glycerol archiving solution for later culturing in the lab and in an RNAlater solution to preserve nucleic acids for sequencing and community analysis. Bacterial isolates will be cultured on several media types and screened for the production of compounds that inhibit growth of a panel of clinically relevant pathogenic bacteria and cancer cell lines.

The second goal was to re-collect bulk samples of the blue ciliate *Folliculinopsis* (blue mat), small amounts of which were collected during the 2009 and 2010 NeMO cruises from the Magic Carpet site near Marker N3. Extractions of these previous collections yielded a blue pigment with inhibitory activity against *Staphylococcus aureus* as well as NCI-H460 human lung cancer cells, but in insufficient quantities to allow full assignment of the chemical structure by NMR spectroscopy. Attempts to re-collect the blue mat at Marker N3 during the 2011 and 2012 cruises were not successful due to the site being completely covered with new lava flow from the 2011 eruption. This year we were able to locate blue mat at both Phoenix and Escargot, and made three large collections using Jason's onboard suction sampler. Combined, these samples total ~500 mL of material and should provide more than enough of the blue pigment for chemical analysis.

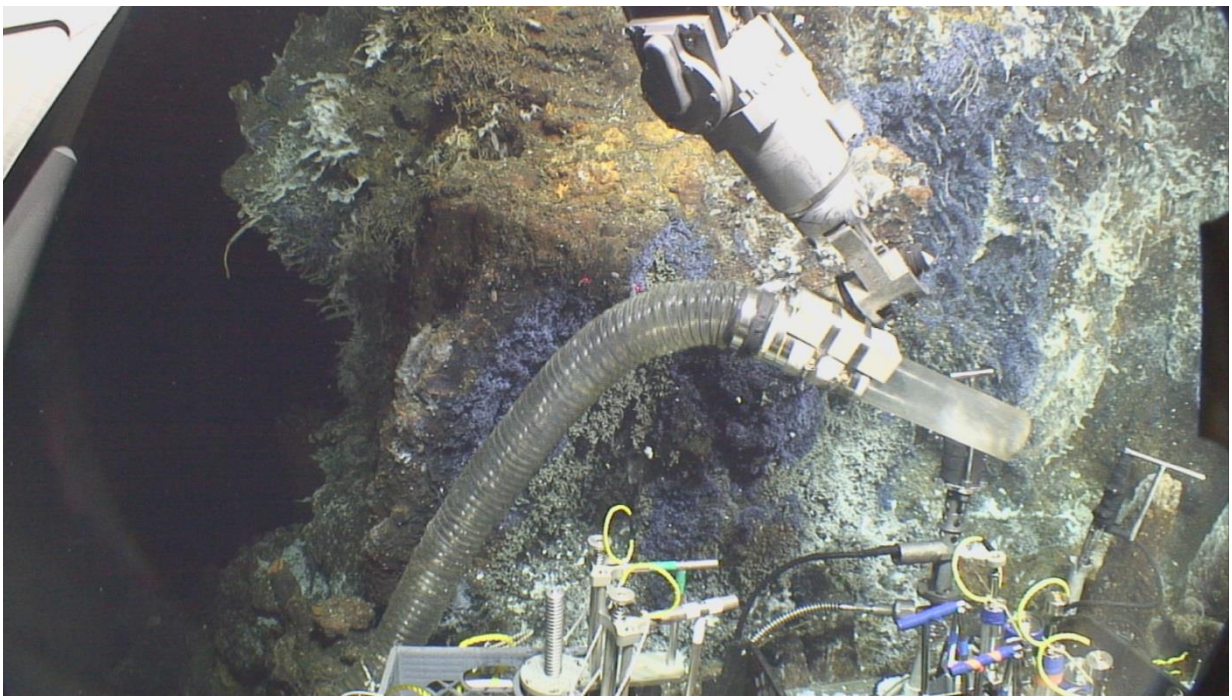


Fig. 4.4-1. Suction sample (J729-microbio-03) of blue mat at Phoenix vent in the ASHES vent field.

Our final goal was to locate and collect bulk samples of a bright red mat that had previously been observed by MBARI researchers in August 2013 near the Trevi vent site. It is unclear whether or not the red material is of biological origin, though similar material has been observed at the Loihi Seamount, and was determined to be iron oxide. Collections will provide material for laboratory cultivation of associated bacteria, metagenomic analysis, and direct chemical analysis.

Three large syringe and one small RNAlater syringe samples of the red mat were collected, as well as one large syringe of nearby tan hydrothermal sediment for comparison. Initial visual and microscopic inspection of the fine red sediment does not suggest that the material is biological and efforts to isolate bacteria are underway.

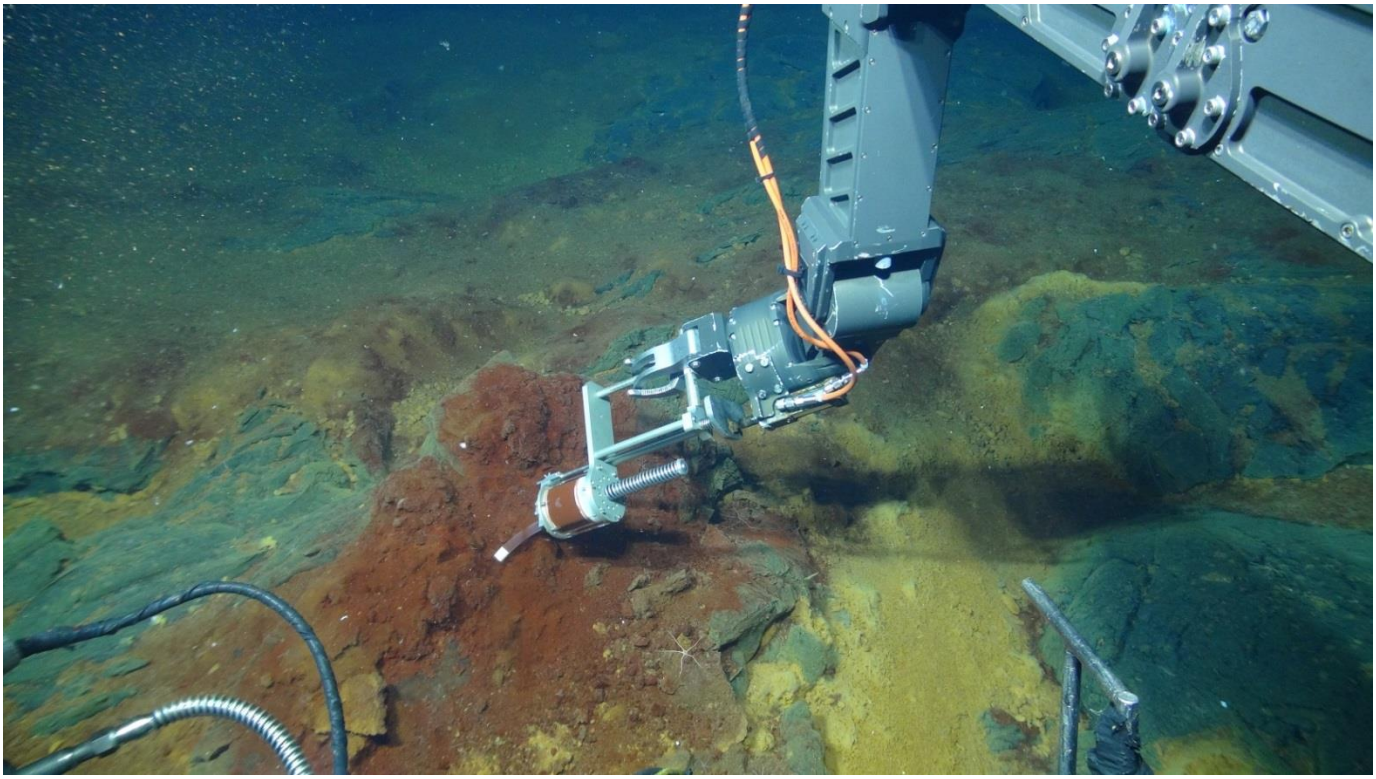


Fig 4.4-2. Sample of red mat at Red Bridges area north of Trevi on dive J2-730 (J730-microbio-22).

4.5 Gas sampling

Leigh Evans, Oregon State University

Axial volcano's high temperature, focused flow fluids were sampled using PMEL's titanium gastight bottles. Some samples were taken using the Fluid Sampler manifold and others transported fluids from vent to bottle using separate individual plumbing. As the spreadsheet shows, very good geographic coverage was attained. Most continue long term time series. The gas concentrations show that in most cases, fluids were likely to be nearly end member composition.

Table. 4.5-1. Total Gas Samples: 20

Sample	Device	Site	Site Description	Sample Information
J726-GTB-16	GTB	Casper	Knocked down chimney and sampling directly in the intense flow.	Green gastight bottle #2. Jason temp probe 314°C.
J726-GTB-19	GTB	Virgin	Chimney fell over. Sampling directly in the intense flow.	Red/green gastight bottle #7. Jason T probe 271.8.
J726-GTB-20	GTB	Virgin		Nude gastight bottle #11. Tried to fire twice becasue the ram wasn't properly positioned the first time. Jason T probe 271.8.
J726-GTHFS-10	GTHFS	Vixen	Knocked down chimney and sampling directly in the intense flow.	Port HFS gastight. T=326. Jason temp probe 344°C.
J726-GTHFS-11	GTHFS	Vixen		Center HFS gastight. T=330. Jason temp probe 344°C.
J726-GTHFS-15	GTHFS	Casper		Stbd HFS gastight. Tmax-310 T2=76. (NOTE: Ram did not move but think sample did fire). Jason temp probe 314°C.
J728-GTB-25	GTB	El Guapo	In direct flow at "boiling flaming" orifice at top of chimney. 14 m off seafloor. Facing SW.	J728-GTB-25 blue-12. Fired in the same orifice as the HFS samples.
J728-GTB-32	GTB	Castle	On ledge near the base in area where the anhydrite chimney was just knocked over and excavated.	White -17 gastight bottle directly in the orifice where the previous 271deg sample was taken.
J728-GTHFS-02	GTHFS	El Gordo	in the same worm clump as the first sample but slightly different location. Still N side of vent.	Starboard red-9 GTHFS. T2=64 Tmax=156.
J728-GTHFS-14	GTHFS	Diva	Hole at the top of the anhydrite mound that used to be the spire base.	GTHFS port purple-10. Temp has dropped significantly; now about 200C. The flush pump had shut off.
J728-GTHFS-15	GTHFS	Diva		GTHFS center orange-16. Tmax= 270.7C.
J729-GTB-04	GTB	Hell	Beehive spigot with intense flow near top (3.4 m up) of sulfide covered in dense biota.	Gastight bottle nude-11 placed in flow of broken-off beehive. Jason temp was 296.5 C.
J729-GTB-06	GTB	Inferno	Excavated hole from largest beehive in this area (not quite at the top) 2.7 meters up the chimney.	Gastight red-green-7 in the excavated hole (that was formerly a large beehive). Jason temp was 310.9C.
J729-GTB-07	GTB	Inferno	Excavated hole from largest beehive in this area (not quite at the top) 2.7 meters up the chimney.	Gastight green-2 in the excavated hole (that was formerly a large beehive). Same position as last sample. Jason temp was 310.9C.
J730-GTHFS-07	GTHFS	Marker N3 vent site. Mkr-135 area.	In diffuse flow coming out of a crack between pillows. White floc and thick white mat at sampling site. Pre/post sample readings: Tmax=20C/19.9; O2= 0.133/0.121 mL/L; pH voltage= 2.766/4.379.	HFS gastight. Purple-10. T=19.2C
J730-GTHFS-16	GTHFS	Trevi	Jason Tmax=257.9 C. In the direct flow at this small anhydrite mound (anhydrite knocked over).	HFS gastight. Red-center-9. T=250C
J730-GTHFS-17	GTHFS	Trevi		HFS gastight. White-stbd-17. T=249C
J731-GTB-12	GTB	Trusty Chimney	Very small chimney on the north side of main Dependable structure. Jason temp=216.2 deg.	Hand-held gastight bottle - green #2.
J731-GTHFS-06	GTHFS	Rusty	Old venting sulfide chimney. Sample position 9 m up; Hdg 256deg. East side of main Dependable structure. Oxygen=0.16	HFS gastight port blue #12. T=41.
J731-GTHFS-10	GTHFS	Small Spire	Area of good flow on spire. North side of main Dependable structure. Looking south. Above and to the right of Mkr-142. Hdg 181 deg.	HFS gastight center orange-16. T=145.

4.6 ONR Vents Energy Harvesting Project

Dave Dyer, Applied Physics Laboratory

The Applied Physics Lab at University of Washington, Maritime Applied Physics Corporation and Creare Inc. are on contract with the Office of Naval Research to explore options for harvesting energy from hydrothermal vents. The team selected three vents in the Axial Seamount area for device installation.

Project Log:

September 6: Installation of Creare device 1 (short tube configuration) at Vixen. (For the purposes of this discussion all weights are considered to be wet weight)

Vixen vent site location: 45° 55.040' N, 129° 59.577' W, 1537 meters

Elevator Deployment

Elevator deployment with the Creare device occurred at 1400 PST. In an effort to get the elevator as close to the vent site as possible, the Jason team requested that the elevator be cable deployed. However, during the cable lowering operations, excessive snap-loads were occurring. Nominal loading on the cable was 470 lbs, but shock loads in excess of 5000 lbs where observed. After a brief debate it was decided to release the elevator for free fall to the sea floor. The acoustic release was initiated and the elevator completed the fall (from 200 meters to 1530 meters) with a controlled and predictable path at a rate of 67 meter/min. This rate is well within the predicted fall rate and within the elevator design parameters. The elevator landed within 105 meters of the desired elevator landing site.

Device Installation

Jason dive start Sept 7, 2013 at 3:30:18 GMT; Jason Virtual Van frame 1470 of dive J2-727. The elevator was located using the USBL system and inspected. All hardware on the device and elevator looked to be intact except the skirt. The device was removed from the elevator without the skirt snagging and transported to the Vixen vent site and set on the sea floor next to the vent. It was observed that the device weight was approximately 100 to 105 lbs. Jason then returned to the elevator and recovered a donut to the vent site. Jason returned to the elevator and attempted, with success, to pick up the elevator and move it closer to the vent site. It is estimated that the elevator weighed approximately 150 to 170 lbs with all drop weights on-board and a single donut on the elevator deck. Once at the vent site, the second donut was removed and placed on the sea floor. The elevator appeared to weight approximately 30 to 60 lbs. With the hardware removed from the elevator, Jason inspected the elevator to ensure the drop platform was free to operate, the pull pin was pulled and the elevator ascended to the surface where it was picked up by RV Thompson (Elevator pin release 6:16:15 GMT, Jason Virtual Van frame 1841). The elevator ascended to the surface in a controlled and predictable path at a rate of 64 m/min. Approximately 25 minutes after the drop platform was activated, the elevator was spotted on the surface (6:40:05) approximately 250 meters on the starboard bow. The elevator was recovered on board. During the elevator recovery the ship lost the forward bow thruster and Jason operations were suspended. After approximately 4 hours the bow thruster was operational again and Jason resumed hardware installation. Upon completion of the hardware installation, we were able to verify the vent effluent was adequately routed through the Creare tubes. Dive ended 9/7/13 15:44:18; Jason Van Virtual frame 2262 of dive J2-727 Total dive time from reaching the elevator to completing the device installation was 12 hr 15 min. However, Jason was in standby mode for approximately 4-1/2 hours. Time for device installation from reaching elevator to Jason leaving installed device site was 7 hrs 45 min.

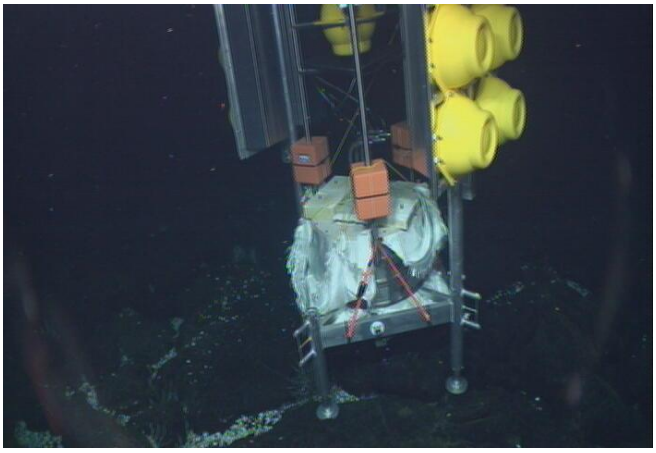


Fig. 4.6-1. Elevator with Creare hardware; skirt damaged during elevator deployment while attached to the winch cable.

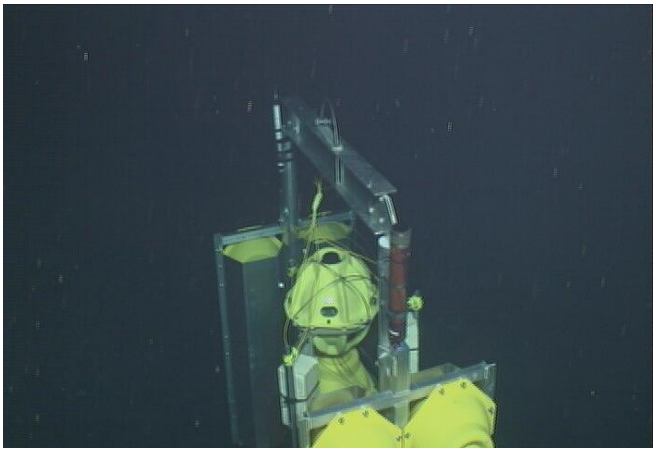


Fig. 4.6-2. Creare hardware with acoustic modem intact.

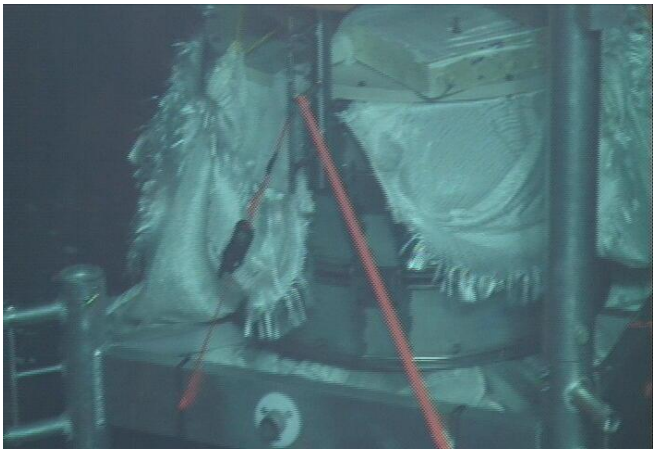


Fig. 4.6-3. Damaged skirt; device secured to elevator.

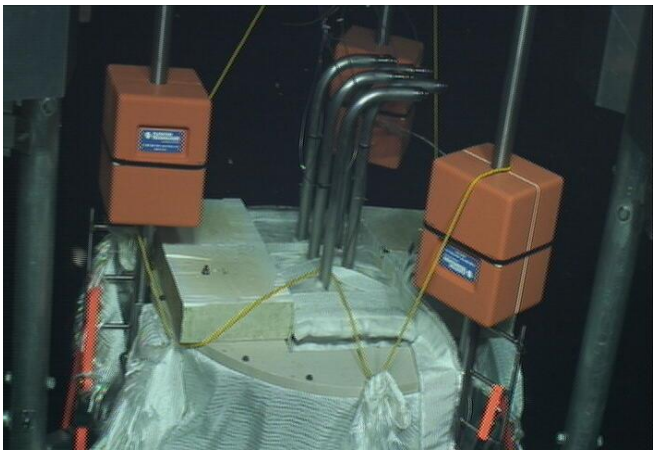


Fig. 4.6-4. Inspection of Creare device after elevator descent; note skirt restraining line (yellow) with damaged skirt.

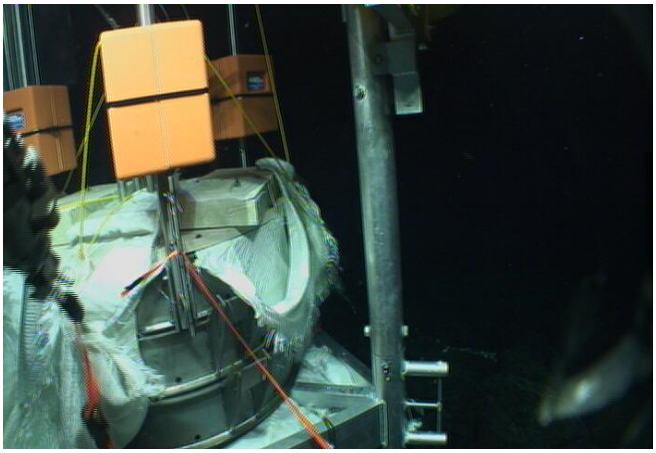


Fig. 4.6-5. Jason cutting tie downs with knife to remove the hardware.

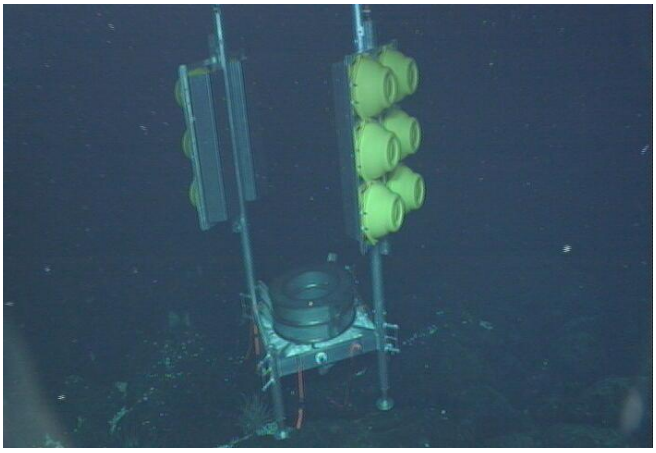


Fig. 4.6-6. View of elevator with donuts after returning from delivering the device to the vent site.

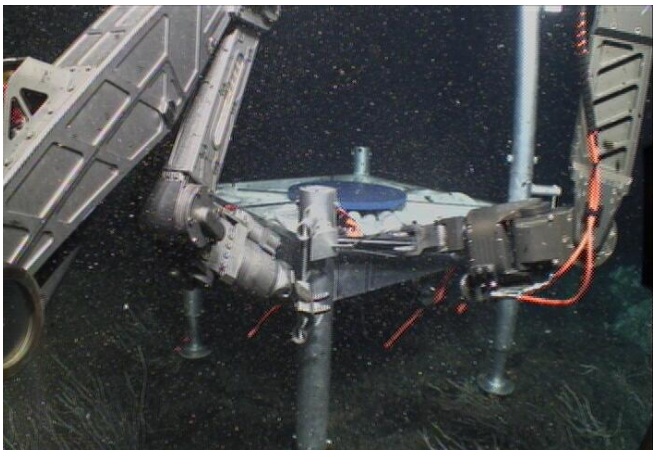


Fig. 4.6- 9. Pulling the drop platform pin on the elevator.

Fig. 4.6-10. Elevator away leaving the sand bags.

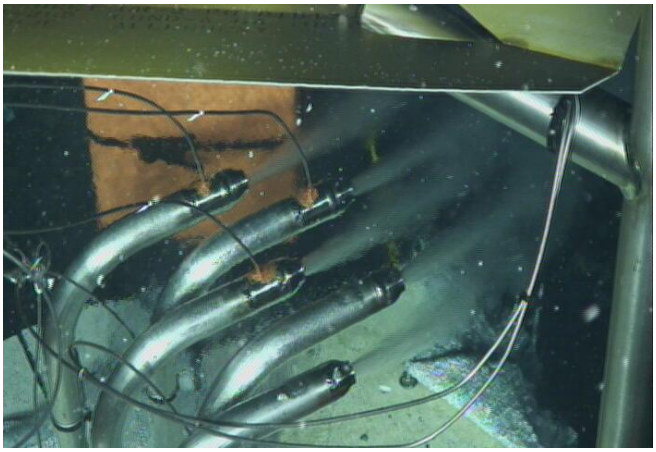


Fig. 4.6-11. Effluent routed thru Creare tubes.

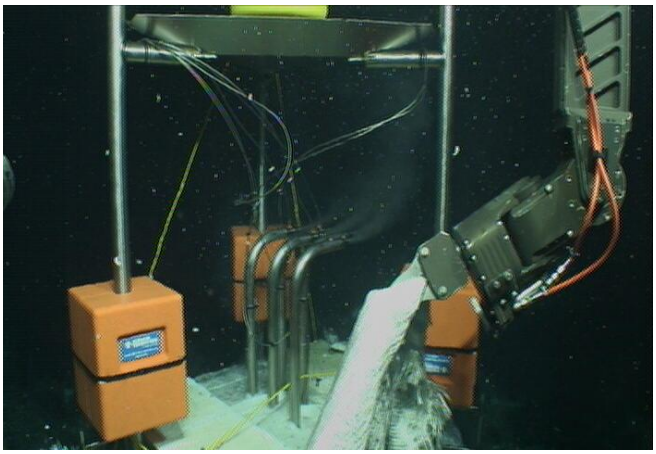


Fig. 4.6-12. Creare installation.

September 8 - MAPC Device Installation

Virgin vent site location: 45° 56.020' N, 130° 0.796' W, 1543 meters

The MAPC hardware was installed on the elevator and released for free fall at approx. 1430 PST. The elevator was tracked to the sea floor and landed approximately 200 meters from the target vent (Virgin) and approximately 150 meters from the nearest RSN hardware. The descent rate was 67 meters/min and had a lateral drift of approximately 50 meters.

The elevator deployment procedures where altered based on the experience of the 1st Creare device deployment. The MAPC device did not have a skirt due to weight concerns of the device assembly. During the elevator deployment, the loaded elevator was lowered approximately 2/3 of the way (10 feet) into the ocean and allow to vent all floodable chambers. Flooding took approximately 15-20 seconds after which, the elevator was lowered until the top lift beam was submerged, and then the sea catch was activated allowing the elevator to begin free fall. This method resulted in a much more controlled deployment, and we did not experience any slack and shock loading even though the seas where approximately as active as the previous deployment. All aspects of lessons learned outlined above where incorporated into the MAPC elevator deployment.

Start of the device installation began Sept 9 at 04:11:34 GMT, Virtual Van frame 4340 of Jason dive J2-728. Upon approach by Jason, the elevator and payload where inspected and found to be intact. The device was removed from the elevator and carried to the vent site. Once the device was relocated, Jason was able to transport the elevator system, including the remaining hardware, to the vent site by dropping 80 lbs of Jason trim ballast. The terrain surrounding Virgin is very uneven with significant small ridges. It was anticipated that significant excavation and leveling would be required to properly place a donut on Virgin. After installation, the Jason thermal probe was placed at the top opening of the resistor load bank heat sink to provide an initial validation that the MAPC panels where functional. A temperature of 7.2°C was measured, which compared to the surrounding sea water temperature of 3.9°C indicating that the MAPC panels were functional and generating power. The Jason thermal probe was also placed at the top of the MAPC panel stack to measure the exit temperature of the effluent which was recorded to be 97.8°C. It is uncertain if the measured temperature is an indication of the amount of heat being removed (earlier dive had recorded Virgin effluent temperature of 272°C) or if significant cold water was being introduced at the base of the installation or if the probe was measuring diffused flow temperatures up off of the device exit ports. Looking at recorded thermocouples and output voltages will provide additional data for a more conclusive understanding of the functionality of the MAPC device. MAPC device installation was completed on Sept 9, 11:28:04 GMT, Virtual Van frame 5090 of dive J2-729.

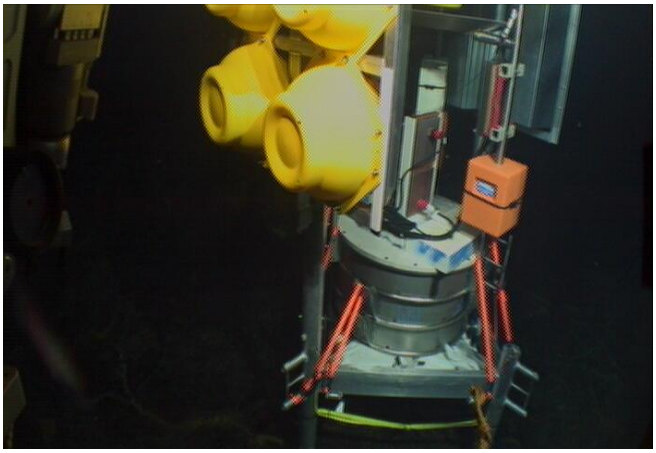


Fig. 4.6-11. Inspection of MAPC device shows all in good condition after descent to sea floor.

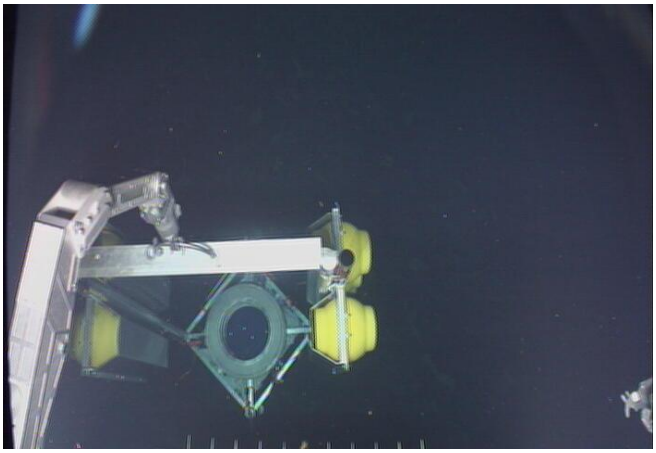


Fig. 4.6-12 Jason carrying elevator with both donuts still onboard.

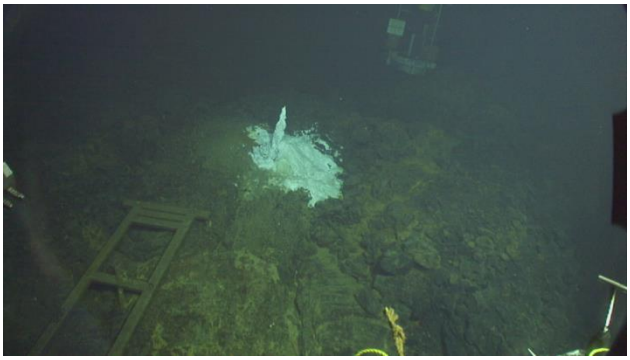


Fig. 4.6-13. Virgin vent; MAPC device in background; old frame in foreground; note drop off on right side of vent.1

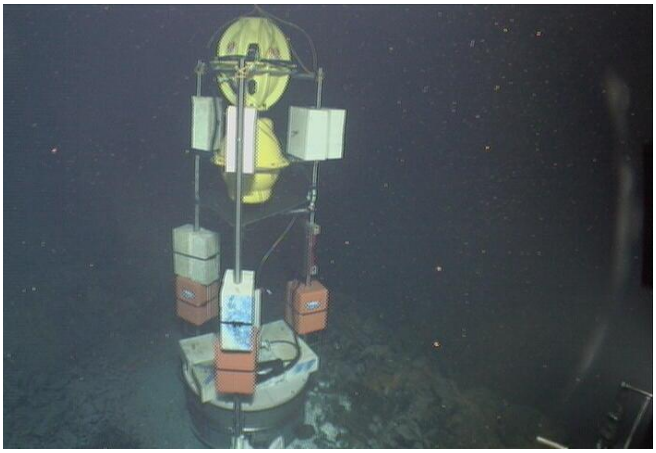


Fig. 4.6-14. Installed device assembly

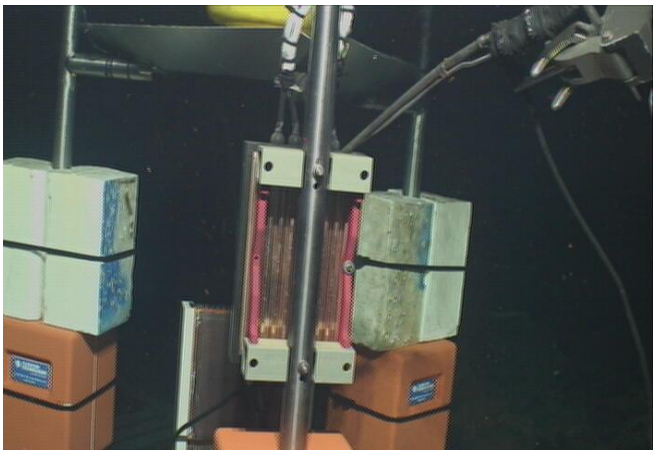


Fig. 4.6-15. Measuring the temperature of water flowing off of resistor load bank heat sink; max temp of 7.2°C.

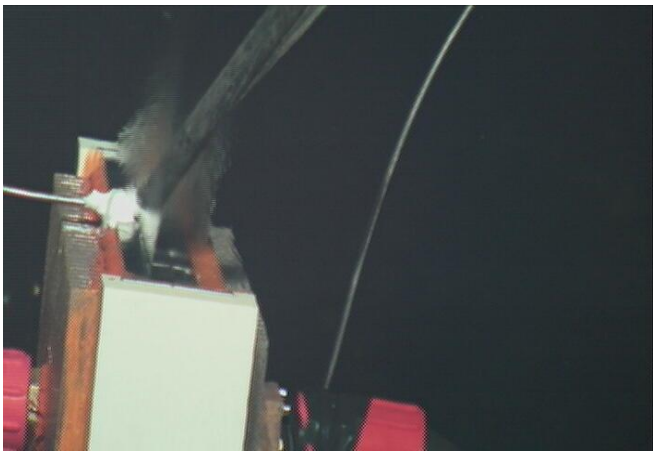


Fig. 4.6-16. Measuring temperature of effluent exiting the top of MAPC device; max temp of 97.8°C.

September 12 – Creare Device 1 Inspection

Visual inspection of Creare 1st install – 5 days after the initial installation; 1651 PST, Virtual Van frame 10701. During dive J2-730, we were able to visually inspect the 1st Creare installation at Vixen vent. We were able to verify that effluent flow was still actively emitting from the Creare device tubes with minimal change in flow volumes compared to that of the initial observations. It was noted that significant anhydrite growth around the device base and on one of the orange floats was present. However, it was apparent that the anhydrite deposits were not impairing on the primary device objectives – maintaining high flow volumes of vent effluent through the device tubes.

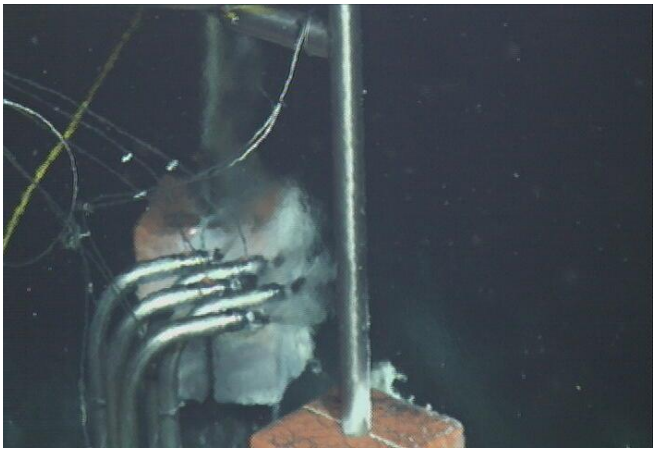


Fig. 4.6-17. Creare Device 1 inspection.

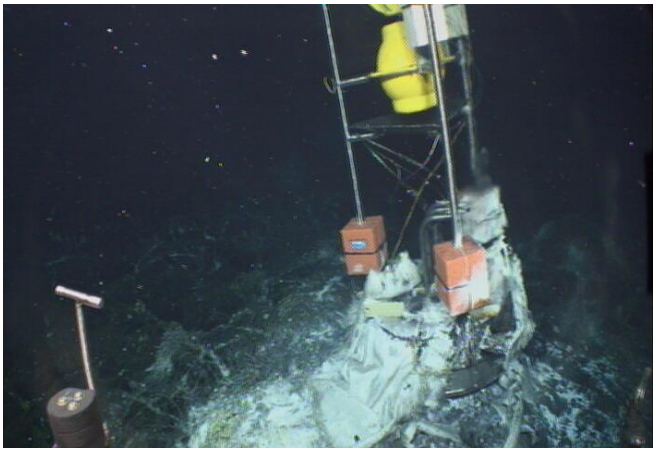


Fig. 4.6-18. Creare Device 1 inspection.

September 14 – MAPC Device Visual Inspection

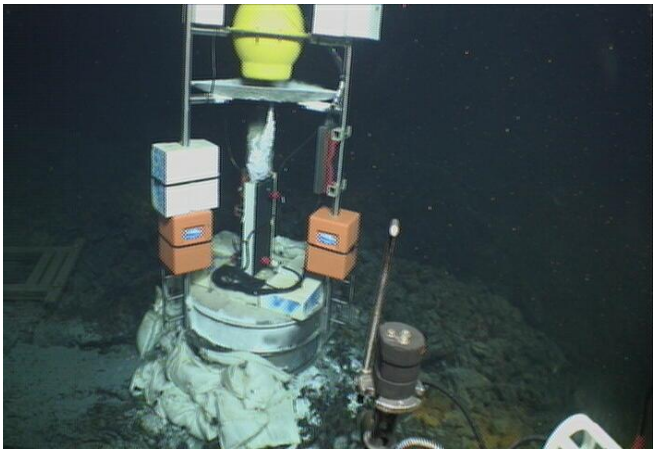


Fig. 4.6-19 MAPC Device inspection.

Later during dive J2-730, we were also able to conduct a visual inspection of the MAPC installation at Virgin vent. We were able to verify that effluent flow was still actively emitting from the MAPC device with minimal change flow volumes compared to the initial observations. Again, there was significant anhydrite growth on top of the MAPC device, but they were not impairing on the primary device objectives –maintaining high flow volumes of vent effluent through the device. Thermal measurements were taken using the Jason thermal probe at the MAPC device effluent exit. A maximum temperature of 240°C was observed.

September 15 – Installation of Creare device 2 (long tube configuration) onto Trevi vent site.

Trevi vent site location: 45° 56.775' N, 129° 59.027' W, 1520 meters

Elevator Deployment

The elevator was free falled as before and descended at a rate of 67 meters/min. The target drop site was approximately 150 meters east of the vent, to avoid areas of collapse west of the vent. Jason control van tracked the elevator to the sea

floor. The final landing site of the elevator was 130 meters east of Trevi. Following the lessons learned on the 1st elevator deployment, this deployment was uneventful with no apparent damage or impact to the device. The fiberglass skirt was installed on the device and survived the deployment with no apparent damage.

Device Installation

Start of device installation began Sept 15 at 20:06:37 GMT, Virtual Van frame 16338 of Jason dive J2-732. Upon approach by Jason, the elevator and payload where inspected and found to be intact. After removing the device from the elevator and relocating it close to the vent, Jason moved the elevator to a location approximately 5 meters from the vent. At this point the elevator assembly total weight was approximately 260 lbs. The device was placed onto the vent. Once the device was secured, the skirt deployment pins where removed by the ROV manipulator arms. Although the skirt is slightly negatively buoyant, the skirt remained in the deployment configuration and required the use of the manipulator arms to pull the skirt down into position around the base of the installation. Once the skirt was deployed, we observed effluent or warmed seawater coming out between one of the device float support tubes and the skirt. Using the ROV thermal probe we measured the temperature of that seawater and found it to only be 6.5 C. We do not anticipate any anhydrite forming at this location since it appears the water temperature is less than the required 150°C to participated anhydrite out of seawater. The temperature out of the Creare tubes was measured to be a maximum of 116.4°C.

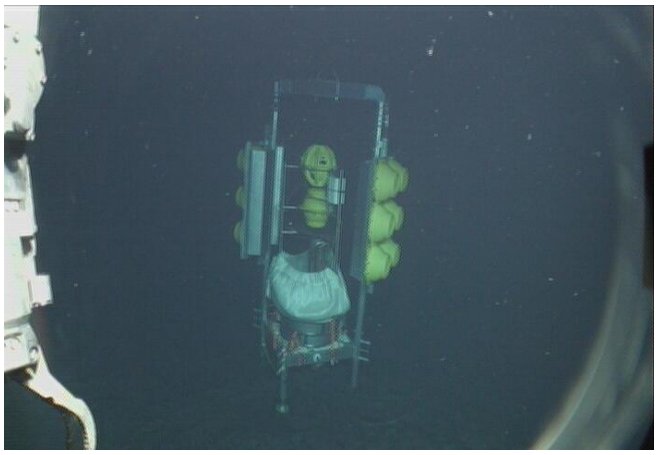


Fig. 4.6-20. Inspection of Creare device shows all in good condition including the skirt.

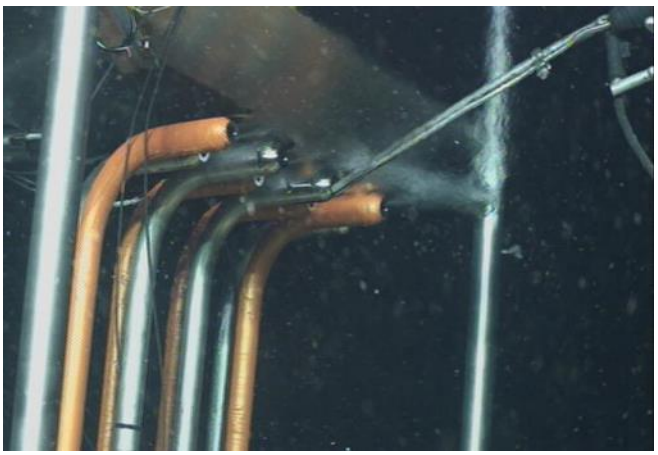


Fig. 4.6-21. Using thermal probe to determine temperature coming out of Creare tubes; max temperature of 116.4°C.

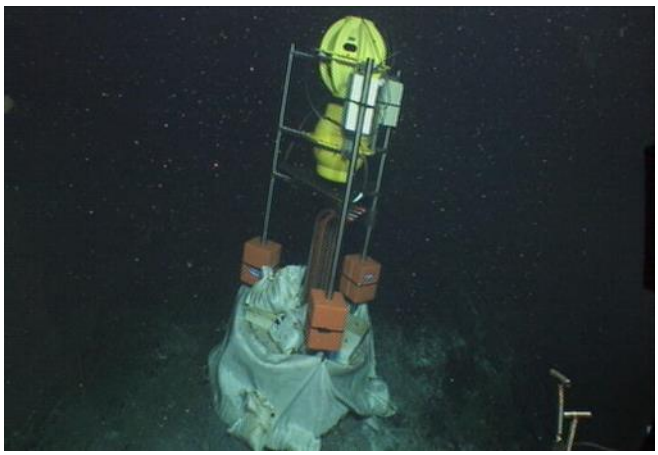


Fig. 4.6-22. Final view of Creare 2 installation.

4.7 Outreach and Education Activities

Rachel Teasdale, California State University - Chico

Ship-to-shore Skype calls to classrooms:

Sixteen ship-to-shore Skype calls (1-3 per weekday) were completed from R/V Thompson to school classrooms in Washington, Oregon, and California (the home states of PIs Chadwick, Butterfield, and Dyer and outreach coordinator Teasdale) and to schools in Tulsa, Oklahoma. The Skype calls were to High School science classes (7); Junior High School classrooms (6); to Elementary School 5th and 6th grade classrooms (2); and to one Professional Development workshop for science teachers who brought questions from their students. We estimate that the classes had at least 30 students per classroom, and at least four Skype calls included multiple classrooms, which resulted in approximately 640 students participating in the calls. During the 16 calls our contact was with at least 23 teachers plus school administrators who attended several calls. The Axial 2013 blog (axial2013.blogspot.com) was integrated into the Skype call activities by allowing the teachers and students to learn about the cruise and prepare questions for the Skype calls ahead of time, and follow the progress of the cruise afterward. The feedback we received from teachers was extremely positive.

Fig. 4.7-1 Scientist Jim Holden and Dave Dyer conducting a Skype call with a classroom on shore.

On board R/V Thompson, Teasdale scheduled two scientists (and/or ROV Jason crew) for each call and communicated scheduled calls to the Captain and ship's crew responsible for internet communications. Times and dates of Skype calls (and therefore Internet interruptions) were posted and updated throughout the ship.

Educational Cruise Blog: http://axial2013.blogspot.com

18 blog entries were created and posted before and during the cruise describing the scientific research projects being conducted onboard and background information to help readers better understand the geologic setting and significance of Axial Seamount. 16 videos were embedded in blogs that introduced scientists, instruments, and life on board the R/V Thompson and research undertaken with ROV Jason. On the blog, links for 17 schools and one general submission link were established for readers to send questions to researchers on board R/V Thompson during the cruise. Questions were answered individually by email and posted online. As of September 24, there were 7798 hits to the blog recorded (the maximum number of hits in one day was more than 1000 hits on Sept 10). One blog entry, "The Science Team" was created from information submitted by 26 (of 36) science team and Jason crew personnel on the cruise, describing their professional background and preparation for their careers and their goals for the cruise. This entry became a very popular entry, with 474 hits. As of September 24, there were 2031 hits to the blog's Questions and Answers pages (including pages for individual schools who participated in Skype calls). As of September 24, there were hits to the blog from 13 countries (US, Canada, Turkey, United Kingdom, S. Korea, Germany, France, Australia, Brazil, Russia, India, Malaysia and Poland).

Table 4.7-1: List of our Skype calls during Axial 2013 Expedition

Skype #	Date	Time	Classroom	Location
1	Mon 9/9/13	8:40-9:45	Pleasant Valley High School	Chico, CA
2	Tues 9/10/13	7:50-8:35	Pleasant Valley High School	Chico, CA
3	Tues 9/10/13	10:50-11:50	Emerson Jr. High School	Davis, CA
4	Tues 9/10/13	2:20-3:20	Newport High School	Newport, OR
5	Weds 9/11/13	8:50-9:50	Tulsa Public High School	Tulsa, OK
6	Weds 9/11/13	11:20-12:20	Willett Elementary	Davis, CA
7	Thurs 9/12/13	9:00-10	Chico Jr. High School	Chico, CA
8	Thurs 9/12/13	10:55-11:50	Scott Valley Jr. High School	Yreka, CA
9	Friday 9/13/13	8:40-9:20	Port Angeles High School	Port Angeles, WA
10	Friday 9/13/13	9:55-10:50	Terrace Park Elem. School	Edmonds, WA
11	Sat 9/14/13	10:55- 11:50	Science Teacher Workshop	Chico, CA
12	Mon 9/16/13	8:00-8:55	Union High School	Tulsa, OK
13	Mon 9/16/13	9:50-10:40	Allen Middle School	Skagit, WA
14	Mon 9/16/13	1:45-3:00	Kamiakin Middle School	Kirkland, WA
15	Tues 9/17/13	8:20-9:20	Sammamish High School	Bellevue, WA
16	Tues 9/17/13	1:20-2:18	University City High School	San Diego, CA
17	Tues 9/17/13	2:30-3:20	The Girls Middle School	Palo Alto, CA

4.8 Moorings

Matt Fowler, Oregon State University

Mooring Operations:

All operations went very smoothly and deployments were conducted during the day in calm conditions. Benchmark floats and APL elevators were released by JASON, and were recovered shortly after surfacing. Deck operations were led by Chief Mate Lloyd Patten using the ship's crane to deploy and recover most moorings over the starboard rail. The APL buoy was deployed using the A-frame and capstan. A few instruments were lowered to the seafloor using the trawl wire, but most deployments allowed the anchor to "freefall" to the seafloor. The second OBH recovered, OBH-2, when recovered had suffered a catastrophic failure of the pressure case during the deployment.

Mooring Operations Log:

09/04 APL Buoy Deployment

This is a taut-line type of mooring with a mooring line length ~98% of the water depth, deployed float first, then the ~1500m of mooring line is streamed out behind the ship, the 6000lb anchor is allowed to freefall last. The 2.5 hour deployment went very well and the anchor settled on the seafloor at the correct depth for the line length used.

09/05 BPR Deployments, OBH Recoveries, BPR WorkBoat Surveys

Bottom Pressure Recorder (BPR) and Ocean Bottom Hydrophone (OBH) Moorings: BPR and OBH moorings are subsurface with ~ 10m line (~30m on OBH) attached to 10 17" glass spheres and have similar instrument configuration with a cylindrical pressure housing mounted horizontally on a table like platform. There is a centrally

mounted acoustic release positioned vertically through the platform connected to the detachable anchor plate beneath the instrument platform, and 10m or 30m line to the floats above.

BPR Deployments: The BPR mooring has short line sections totaling ~ 10m and is assembled prior to deployment. The floats are deployed over the side via a slip line and allowed to float in the water while the crane lifts the platform over the side. It then lowers the platform to the sea surface where the 5 minute process is concluded by releasing the instrument using a Sea Catch quick release and allowing the mooring to free-fall to the seafloor. All 3 BPR moorings were deployed in less than 2 hours.

OBH Recoveries: The OBH's positioned on the east and west of the caldera were recovered. Each recovery took under 1 hour from when the release code to drop the anchor was issued, until the instrument was on board. Recovery was accomplished by first capturing the floating line attached to the floats and hooking it to the crane for retrieval. The easternmost OBH, OBH-2 failed catastrophically during the recovery resulting in the destruction of one instrument and the loss of 2 years of data.

OBH-2 Pressure Housing Failure: Post cruise analysis indicates a small leak at the hydrophone penetration of the pressure case end cap allowed a small amount of seawater, ~1L, in equalizing pressure at some point during the deployment. When the instrument ascent began, the internal pressure soon exceeded the external pressure. At some point, the pressure differential exceeded the ability of the end cap to contain the internal pressure resulting in the forceful expulsion of the end cap and internal frame of the instrument. The stainless steel hose clamp securing the end cap in place is replaced every turnaround, however on the previous turnaround, the replacement part was a substandard one. The worm gear was not stainless and corroded, resulting in a weakened clamp that failed before the pressure release valve operated.

BPR WorkBoat Surveys: During the 1.5hr operation, BPR Center was surveyed, and a partial survey of BPR South-2 was done. The APL elevator deployment site was near BPR South-2, so a partial survey (all time permitted) was done to verify the instrument settled on the seafloor near the target deployment location. BPR South-2 was re-surveyed later in the cruise.

09/06 Benchmark Deployments, APL Elevator Deployed over Coquille

Benchmark Deployments: Benchmarks must be first free-fall deployed from the ship, then moved into final position with a submersible vehicle. The mooring is designed to be deployed with extra, detachable, weight and flotation. The mooring was pre-assembled, the crane then lifts the entire mooring from the top of the floats over the rail and lowers it into the sea. Using a quick release, the mooring is allowed to free-fall to the approximate deployment site. During a subsequent JASON dive, the ROV pulls a pin releasing the extra weight. The benchmark, with the floats still attached, is now slightly negatively buoyant, and is easily maneuvered by ROV into the exact position required. JASON then pulls another release pin, this time releasing the floats, permanently mooring the benchmark in place. The surface portion of the benchmark deployments took about 5 minutes. AX-307 and AX-308 were deployed.

APL Elevator Deployments: The APL group used an elevator to lower their instruments to the seafloor, then required extensive ROV operations to move vent cap from elevator to vent and properly emplace it. After the vent cap is removed, the weights are jettisoned and the now positively buoyant elevator returns to the surface for retrieval. The initial plan was to lower the elevator to the seafloor using the ship's trawl wire, however due to high drag of elevator, even in modest conditions extremely violent snap loading, exceeding 3G acceleration, began to occur as the ship rolled in calm seas. Due to concerns of damage to either ship, elevator, or the instrument from the snap loading the decision was made to release the elevator and allow it to free fall the remaining distance into position. All subsequent elevator deployments were free fall deployed from the surface.

APL Elevator Deployed over Coquille: The 12' elevator is pre-assembled on deck, the trawl wire attached to the top of the elevator via a quick release. The unit is lifted over the rail and lowered into the sea. For the first deployment, an acoustic release was attached to the trawl wire with the intent of lowering the elevator to the seafloor, then activating the acoustic release to disconnect the trawl wire from the elevator. This method had to be abandoned due to severe snap loading described above. The acoustic release was replaced by a Sea Catch quick release and deployments modified from "lowered by wire" to "free fall" type.

09/07 Benchmark Deployments, Random Access Sampler (RAS), Self-Calibrating Pressure Recorder (SCPR)

Benchmark Deployments: Benchmark AX-303 and AX-310 were deployed as previously described.

APL Elevator Recovered: The APL elevator deployed at Coquille vent site was released from the seafloor and recovered after surfacing.

Random Access Sampler (RAS): The mooring is pre-assembled and free fall deployed, and has two drop weights when deployed. The ROV pulls a release pin dropping the primary weight when it reaches the seafloor, it can now move the RAS to the vent for sampling. The RAS is positioned by the ROV close to vent site and a probe is extended from the RAS to the vent for duration of deployment. The second drop weight remains attached until the end of the ~ 1 year deployment period, when it is then dropped by ROV and the RAS returns to the surface for recovery.

Self-Calibrating Pressure Recorder (SCPR): The SCPR is lowered by wire to the seafloor then repositioned by JASON to the target. The ~30m mooring was pre-assembled into subsystems and deployed instrument platform first. The line was stopped off and the next assembly was attached, and deployed. When the entire mooring was overboard, but still attached to the wire, the trawl winch was paid out until the SCPR was allowed to free fall from 50m off the seafloor. The ROV repositioned SCPR into the final position for deployment.

09/08 Benchmark Deployments, APL Elevator Deployed over ASHES, OBH WorkBoat Survey

Benchmark Deployments: Benchmarks AX-302 and AX-309 free fall deployed, repositioned by JASON

APL Elevator Deployed over ASHES: APL elevator free fall deployed. Vent cap repositioned by ROV.

OBH WorkBoat Survey: OBH-North was not surveyed after deployment in 2011. A 30 minute duration WorkBoat acoustic survey was conducted prior to recovery of the mooring.

09/09 OBH Recovery, BPR & OBH WorkBoat Surveys, APL Elevator Recovered, OBH Deployment

OBH Recovery: Recovery was completed quickly. 32 minutes after issuing the release code to drop the anchor, the instrument was on board. Recovery was accomplished by first capturing the floating line attached to the floats and hooking it to the crane for retrieval.

BPR WorkBoat Survey: Acoustic survey of BPR South -1 and complete acoustic re-survey of BPR South-2 were done in just over two hours.

APL Elevator Recovered: The APL elevator deployed at ASHES vent site was released from the seafloor and recovered after surfacing.

OBH Deployment: OBH South was pre-assembled, the floats were lowered over the side using a slip line and released into the water next to the ship. The instrument platform was then lifted with the crane, attached to the top of the acoustic release by a quick release. It was lowered over the rail and into the water 3-4m before tripping the release for a free fall descent.

OBH WorkBoat Survey: 45 minute WorkBoat acoustic survey conducted following procedures detailed above.

09/15 APL Elevator Deployment over TREVI

APL elevator free fall deployed. Vent cap repositioned by ROV to final position.

09/16 APL Elevator Recovery, APL Buoy Recovery

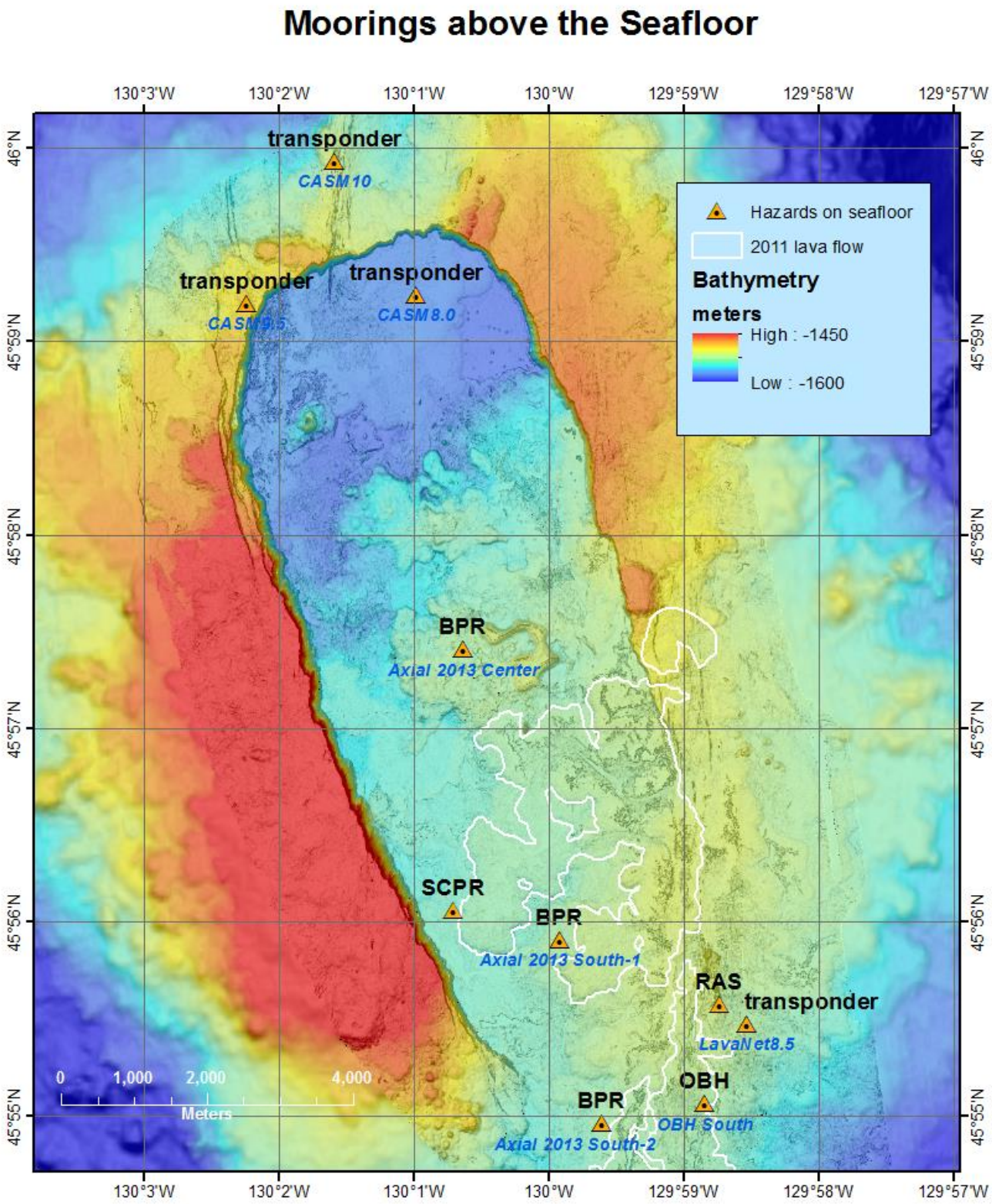
APL Elevator Recovery: The APL elevator deployed at TREVI vent site was released from the seafloor and recovered after surfacing.

APL Buoy Recovery: Buoy lifting line attached to crane and recovered over starboard rail. Load was transferred to capstan and 1500m of line was recovered using the capstan.

Table 4.8.1 Mooring Operations

Instrument	Latitude	Longitude	Depth	Notes	Deployed	Recovered
	Surveyed positions unless otherwise indicated.					
APL BUOY	45.91798	-130.01720	1484	on rim ~1.7 km SSW of ASHES	9/4/2013	9/16/2013
OBH-S	45.91769	-129.98085	1539	There was no OBH-S in 2011	9/9/2013	
OBH-2 (East)	45.94132	-129.97717		recovery: end of 2-year deployment	7/25/2011	9/5/2013
OBH-3 (West)	45.93199	-130.01717		recovery: end of 2-year deployment	7/27/2011	9/5/2013
OBH-4 (North)	45.95983	-130.00836		recovery: end of 2-year deployment	7/27/2011	9/9/2013
BPR-center	45.95678	-130.01060	1541	~200 m NNW of AX-101	9/5/2013	
BPR-south1	45.93181	-129.99876	1540	Near AX-308	9/5/2013	
BPR-south2	45.91599	-129.99348	1540	~160 m SSW of Vixen, ~320 m W of AX-304	9/5/2013	
AX-302 @ Trevi	45.94642	-129.98378	1522	~100 m ENE of Trevi vent	9/8/2013	
AX-303 @ Marker 33	45.93346	-129.98225	1516	same as AX-203	9/7/2013	
AX-307 @ Magnesia West	45.94535	-130.00906	1544	~1.4 km NNW of ASHES	9/6/2013	
AX-308 @ BPR-South1	45.93160	-129.99880	1533	~200 m S of RSN cable	9/6/2013	
AX-309 @ RSN PN	45.93835	-129.97208	1527	~200 m SE of RSN J-box	9/8/2013	
AX-310 @ IntDist	45.92580	-129.97787	1531	~150 m S of RSN2 J-box	9/7/2013	
(Benchmarks: final positions and depth after ROV placement)						
RAS mooring @ IntDist	45.92615	-129.97890	1521	~50 m S of RSN1 J-box	9/7/2013	
(RAS: final positions and depth after ROV placement)						
APL elevator @ Vixen	45.91733	-129.99310	1530	~10 m W of Vixen	9/6/2013	9/7/2013
APL elevator @ ASHES	45.93345	-130.01320	1539	~10 m SE of Virgin	9/8/2013	9/9/2013
APL elevator @ Trevi	45.94628	-129.98357	1515	~10 m E of Trevi	9/15/2013	9/16/2013
(Elevators: drop positions)						
SIO-SCPR mooring	45.93438	-130.01178	1541	~20 m SW of AX-106, ~50 m from RSN cables	9/7/2013	
(SCPR: final positions and depth after ROV placement)						

Figure 4.8-1 Moorings above the seafloor after the 2013 expedition.



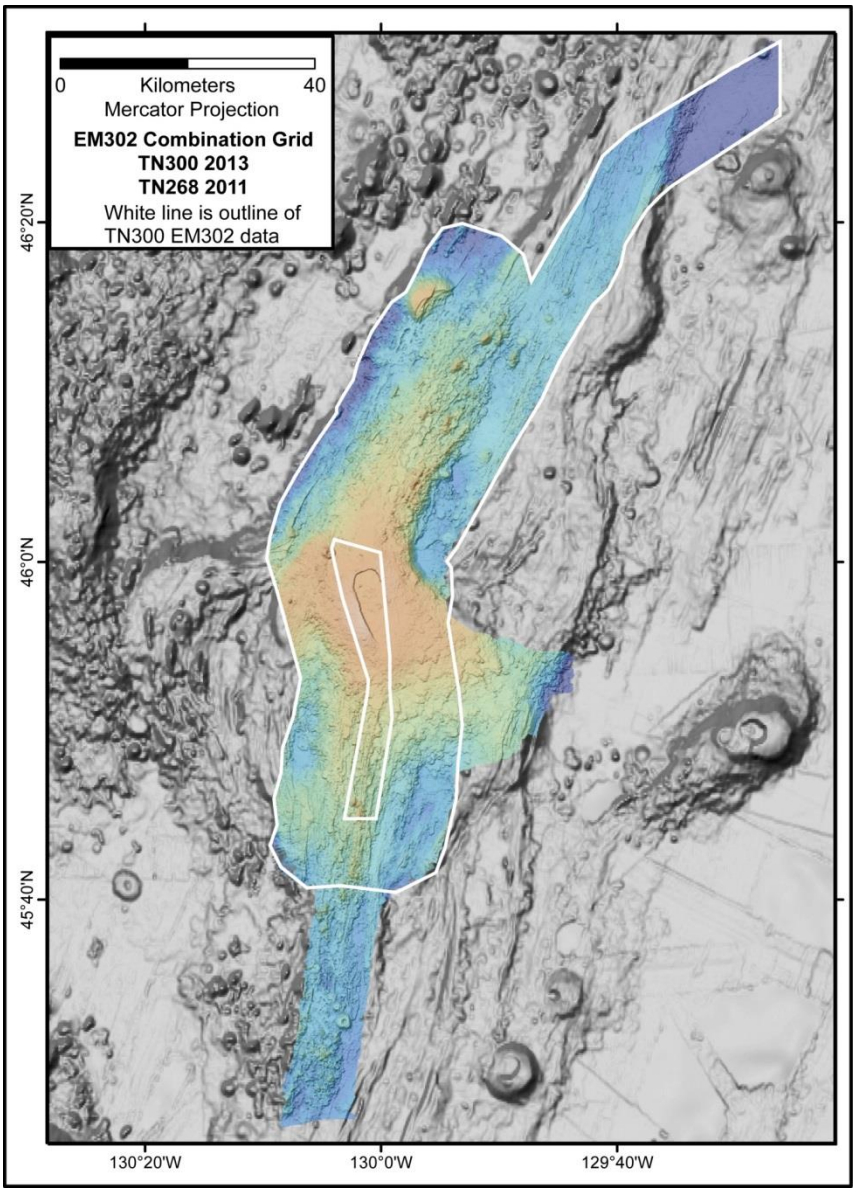
4.9 EM302 Multibeam Mapping

Susan G. Merle, OSU

EM302 multibeam data (bathymetry and backscatter) were collected when all other operations were completed at Axial Volcano during the Axial 2013 expedition (Figure 4.9-1). The multibeam data survey occurred from 9/17 0258 – 1520 UTC. The survey area covered 1575 km^2.

The multibeam data were collected to increase EM302 coverage in the area, particularly along Axial's north rift zone and part of the adjacent CoAxial segment. The Axial 2013 (TN300) survey plan was designed to add coverage, butting up to EM302 data collected by University of Washington in 2011 (TN268). There is extensive EM300 data coverage at Axial, but the new and improved EM302 system has added more beams per ping, increasing data density dramatically. The EM300 system provides a total of 135 beams (soundings) per ping, compared to the newer EM302 which can collect up to 432 beams per ping. A preliminary look at the data has been completed. The data were cleaned with the 3D editor mbeditviz. A more critical look at the data will take place in the near future. The survey speed was 8 knots. Data quality is good to excellent and can be easily gridded at 20 meter resolution.

Figure 4.9.1 Multibeam data collected on the TN300.



4.10 CTDs

In 2013, we conducted 6 CTD casts in and around the caldera to gather time-series data on the extent of the hydrothermal plumes over Axial. The primary goal was to characterize the intensity and depth of the plumes (based on transmissometer signal from particles). We did one background cast SW of the caldera. Time series stations over ASHES, International District (Castle), Trevi, and CASM were occupied. We collected some samples for shipboard GC measurement of methane and hydrogen, preserved helium samples in copper tubes, and saved trace metal samples..

GMT Date/Time	CTD	Area/Purpose	Latitude	Longitude
9/5/2013 02:11	CTD V13A-01 / TN300-01-01	background	45.93202	-130.14608
9/5/2013 04:53	CTD V13A-02 / TN300-02-01	Trevi Vent	45.94680	-129.98263
9/14/2013 20:00	CTD V13A-03 / TN300-003-01	Castle Vent	45.92615	-129.98012
9/16/2013 20:35	CTD V13A-04 / TN300-004-01	ASHES	45.93342	-130.01367
9/16/2013 22:50	CTD V13A-05 / TN300-005-01	Trevi Vent	45.94617	-129.98370
9/17/2013 01:13	CTD V13A-06 / TN300-006-01	CASM	45.98902	-130.02732

(GMT was 7 hours ahead of local time)

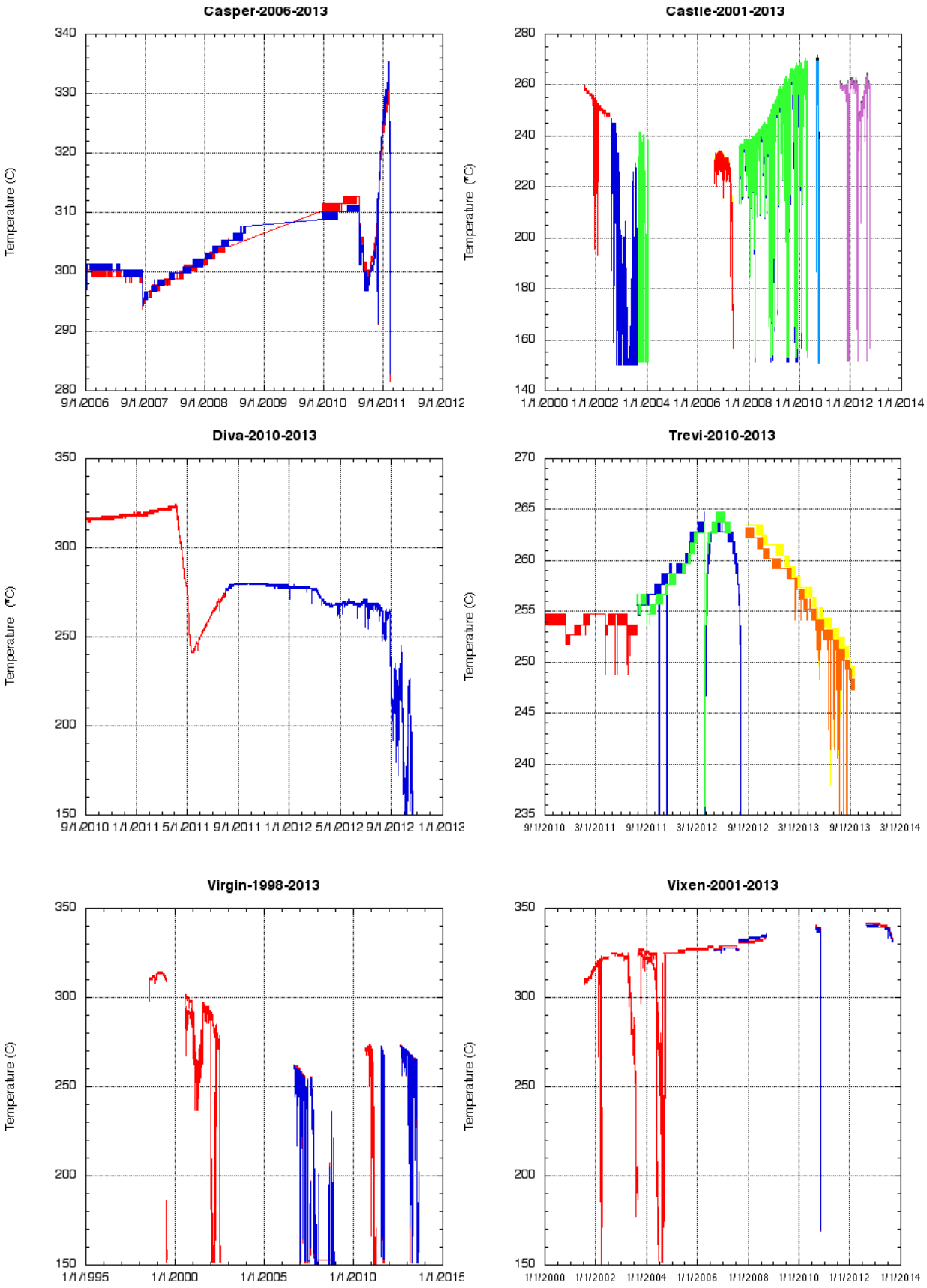
4.11 Hydrothermal Vent Fluid Temperature Recorders

As in the past, we recovered and deployed two kinds of temperature recorders: miniature temperature recorders (MTRs) for low-temperature vents (max temp ~60°C), and HOBO or MISO high-temperature recorders (the two names are used interchangeably, the MISOs are just newer versions of the HOBOs, and have two sensors for redundancy instead of one) for temperatures between 152-419°C. Generally, MTRs are deployed at diffuse vents and HOBOs at high-temperature anhydrite vents. The main difference this year is that we could not deploy HOBO recorders at the anhydrite vents where the APL Vent Caps were deployed (Trevi, Virgin, and Vixen). This will interrupt the long-term temperature time-series at these vents, but hopefully the vent caps will provide a temperature record to fill the gap.

The long-term HOBO records show:
* The temperature at Casper decreased after the 2011 eruption, then it turned around and has been getting hotter since June 2011.
* Diva, which also went down after the 2011 eruption, sort of leveled off before it got back up to its pre-eruption temperature.
* Trevi went up in 2011-2012, then went back down again in 2012-2013.
* Castle has a nice downward then upward trend between the 1998 and 2011 eruptions.
* The Virgin record is mostly a downward trend, but is also problematic because the probes fell out of the vent often.
* Vixen shows mostly an upward trend.

Casper, Diva, and Trevi were recording during the 2011 eruption; Castle, Virgin, and Vixen were not.

Figure 4.11-1 Graphs of time-series temperature data at various venting locations.



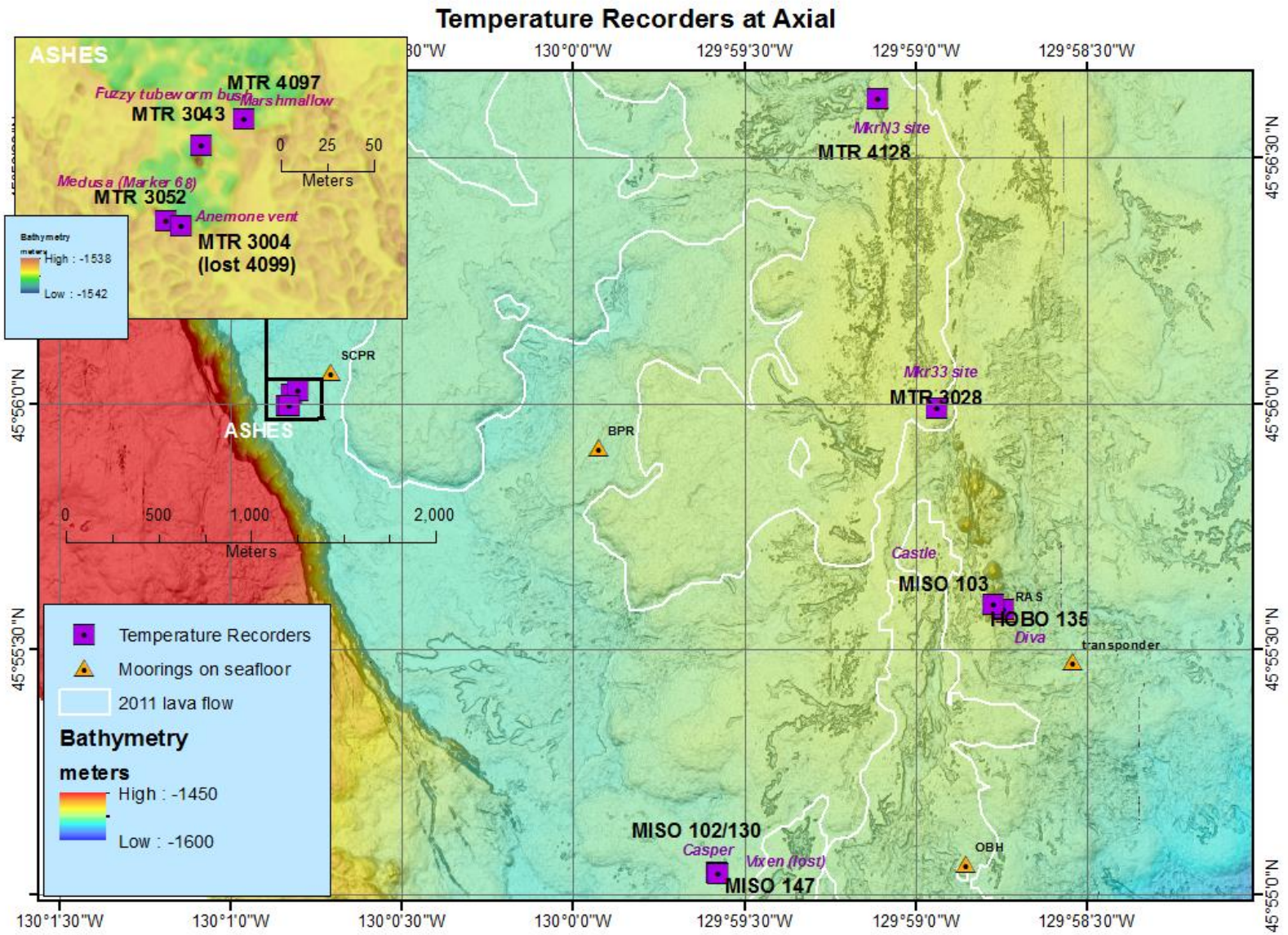


Fig. 4.11.1 Temperature recorders remaining at Axial after the 2013 expedition. All devices were deployed in 2013 with the exception of MISO 147 at Vixen (2011 deployment) and MTR 4099 at Anemone (2012 deployment) which were not found for recovery in 2013. ASHES inset map bathymetry data were shifted +9X/-3Y from the original grids provided by MBARI in 2011 to best fit the vent and marker locations.

Table 4.11.1 Temperature recorder instrument deployment and recoveries.

Location of Device	Instrument	Deployed	Recovered	Comments	Latitude	Longitude	Depth	Heading	Virtual Van #
DEPLOYED 2013									
Medusa (Marker 68)	MTR 3052	J2-726		Replaced MTR 4098.	45.93328	-130.01389	1544	334	874
Anemone vent	MTR 3004	J2-726		Placed where J726-28 sampled.	45.93325	-130.01379	1542	218	1019
Fuzzy tubeworm bush	MTR 3043	J2-726		Replaced MTR 3041.	45.93364	-130.01366	1542	91	1234
Marshmallow	MTR 4097	J2-726		Replaced MTR 3334.	45.93377	-130.01336	1541	293	1260
Diva	HOBO 135	J2-728		In vent; fell down side initially.	45.92637	-129.97906	1521	66	3260
Castle	MISO 103	J2-728		In sampling position J728-31.	45.92654	-129.97954	1515	23	4026
Casper	MISO 102	J2-730		Deployed in flow-may not be exact.	45.91744	-129.99298	1534	163	10945
Casper	MISO 130	J2-730		Deployed in flow orifice.	45.91744	-129.99298	1534	163	10979
Marker 33	MTR 3028	J2-730		In diffuse flow; replaced 4095.	45.93316	-129.98228	1515	205	11920
Marker N3	MTR 4128	J2-730		Replaced MTR 3332.	45.94370	-129.98518	1521	269	12450
RECOVERED 2013									
Virgin	MISO 129	J2-660	J2-726		45.93366	-130.01322			
Vixen	MISO 101	J2-661	J2-726		45.91733	-129.99295			
Casper	MISO 141	J2-581	J2-726	2012	45.91745	-129.99303			
Hell Marker 68	MTR 4098	J2-660	J2-726	Deployed near marker 68.	45.93332	-130.01396			
Fuzzy tubeworm bush	MTR 3040	J2-660	J2-726	Deployed in 2012 sampling spot	45.93364	-130.01366			
Fuzzy tubeworm bush	MTR 3041	J2-580	J2-726	Not recovered. Need to find next year.	45.93364	-130.01370			
Marshmallow	MTR 3334	J2-580	J2-726	Did not visit in 2012.	45.93374	-130.01343			
Diva	HOBO 153	J2-583	J2-728	Unable to visit this vent in 2012	45.92640	-129.97896			
Castle	MISO 102	J2-583	J2-728	Unable to visit this vent in 2012	45.91734	-129.99294			
Trevi	MISO 104	J2-661	J2-730		45.94628	-129.98371			
Marker N3	MTR 3332	J2-661	J2-730	Deployed in same spot where 3312 was recovered.	45.94372	-129.98516			
Marker 33	MTR 4095	J2-661	J2-730	Installed where RAS intake was 2011-12.	45.93320	-129.98227			
Boca	MTR 4001	J2-661	(Falkor 2013)	"52" on float on polypro line.	45.92769	-129.98248			
Mkr113 Vent (Mkr 62)	MTR 4127	J2-661	(Falkor 2013)	Near HFPS sampling spot	45.92274	-129.98810			
Not Found (Lost?) 2013									
Anemone vent	MTR 4099	J2-660	LOST?	(2012) Placed where 4096 was.	45.93325	-130.01379		308	529
Vixen	MISO 147	J2-581	LOST	(2011)Must be buried in anhydrite.	45.91737	-129.99296		291	7684

5 - Imagery

Jason records video from 3 cameras to DVD in standard definition: Brow Cam, Pilots Pan/Tilt and the HD Science camera. There are 2 original copies of all three camera's data (one for Science and one for the WHOI archive). Below is a list of the DVDs recorded during the cruise.

JASON DVD Video List

DVD_Id	Start Date/Time	End Date/Time	Dive	Site	Time Rec
DVD-001	*9/6/2013 0:36*	*9/6/2013 2:36*	J2-726	Vixen Vent	2:00:00
DVD-002	*9/6/2013 2:34*	*9/6/2013 4:34*	J2-726	Vixen Vent	1:59:37
DVD-003	*9/6/2013 4:32*	*9/6/2013 6:32*	J2-726	Casper Vent	2:00:00
DVD-004	*9/6/2013 7:55*	*9/6/2013 9:55*	J2-726	Virgin	2:00:00
DVD-005	*9/6/2013 9:53*	*9/6/2013 11:53*	J2-726	Anemone	2:00:00
DVD-006	*9/6/2013 11:52*	*9/6/2013 13:52*	J2-726	Phoenix/Inferno	2:00:00
DVD-007	*9/6/2013 13:50*	*9/6/2013 14:03*	J2-726	Exploring ASHES vents	0:13:00
DVD-008	*9/7/2013 3:09*	*9/7/2013 5:09*	J2-727	APL elevator 100m to VIXEN-	2:00:00
DVD-009	*9/7/2013 5:07*	*9/7/2013 7:07*	J2-727	APL elevator 48m to VIXEN-	2:00:00
DVD-010	*9/7/2013 6:56*	*9/7/2013 12:04*	J2-727	Ship Bow thruster problem, JASON above seafloor*	5:08:00
DVD-011	*9/7/2013 11:49*	*9/7/2013 13:49*	J2-727	Deploying sand bags at Vixen to hold donut	2:00:00
DVD-012	*9/7/2013 14:19*	*9/7/2013 15:34*	J2-727	Continue putting cap on Vixen	1:15:00
DVD-013	*9/7/2013 15:45*	*9/7/2013 17:45*	J2-727	Engineering dive	2:00:00
DVD-014	*9/8/2013 4:20*	*9/8/2013 6:20*	J2-728	El Gordo	2:00:00
DVD-015	*9/8/2013 6:18*	*9/8/2013 8:18*	J2-728	Fluid Sampling at El Gordo	2:00:00
DVD-016	*9/8/2013 8:16*	*9/8/2013 10:16*	J2-728	Fluid Sampling and HOBO recovery at DIVA	2:00:00
DVD-017	*9/8/2013 10:14*	*9/8/2013 12:14*	J2-728	El Guapo	2:00:00
DVD-018	*9/8/2013 12:13*	*9/8/2013 14:13*	J2-728	El Guapo	2:00:00
DVD-019	*9/8/2013 14:13*	*9/8/2013 16:13*	J2-728	El Guapo and Castle	2:00:00
DVD-020	*9/8/2013 16:09*	*9/8/2013 18:09*	J2-728	Transit to move benchmark AX-310	2:00:00
DVD-021	*9/9/2013 4:05*	*9/9/2013 6:05*	J2-729	Carrying vent cap from elevator to Virgin vent	2:00:00
DVD-022	*9/9/2013 6:03*	*9/9/2013 8:03*	J2-729	Transiting and positioning donut on Virgin vent	2:00:00
DVD-023	*9/9/2013 8:01*	*9/9/2013 10:01*	J2-729	Elevator release and recovery	2:00:00
DVD-024	*9/9/2013 9:59*	*9/9/2013 11:59*	J2-729	Installing vent cap at Virgin vent	2:00:00
DVD-025	*9/9/2013 11:58*	*9/9/2013 13:58*	J2-729	Pheonix and Hell and Inferno	2:00:00
DVD-026	*9/9/2013 13:56*	*9/9/2013 14:50*	J2-729	SCPR mooring	0:54:00
DVD-027	*9/10/2013 0:16*	*9/10/2013 2:20*	J2-730	BMRK-308 in place at BPR south location.	2:04:00
DVD-028	*9/10/2013 2:33*	*9/10/2013 4:33*	J2-730	BPR south location then transit to Ashes	2:00:00
DVD-029	*9/10/2013 4:31*	*9/10/2013 6:31*	J2-730	Ashes AX106 then transit to Magnesia West	2:00:00
DVD-030	*9/10/2013 6:30*	*9/10/2013 8:30*	J2-730	AX-307 then transit to AX-101	2:00:00
DVD-031	*9/10/2013 9:07*	*9/10/2013 11:07*	J2-730	AX-101 then transit to AX-202/303	2:00:00
DVD-032	*9/10/2013 11:48*	*9/10/2013 13:48*	J2-730	TREVI	2:00:00
DVD-033	*9/10/2013 15:35*	*9/10/2013 17:35*	J2-730	AX-309 benchmark	2:00:00
DVD-034	*9/10/2013 19:09*	*9/10/2013 21:09*	J2-730	AX-303 benchmark	2:00:00
DVD-035	*9/10/2013 22:22*	*9/11/2013 0:22*	J2-730	AX-310 benchmark	2:00:00
DVD-036	*9/11/2013 1:30*	*9/11/2013 3:30*	J2-730	AX-104 benchmark**	2:00:00
DVD-037	*9/11/2013 7:03*	*9/11/2013 9:03*	J2-730	AX-105 benchmark	2:00:00
DVD-038	*9/11/2013 11:43*	*9/11/2013 13:43*	J2-730	AX-104 benchmark	2:00:00
DVD-039	*9/11/2013 13:52*	*9/11/2013 15:52*	J2-730	AX-310 transit to AX-203 benchmark	2:00:00
DVD-040	*9/11/2013 15:50*	*9/11/2013 17:50*	J2-730	AX-203 to AX-303 benchmark	2:00:00
DVD-041	*9/11/2013 17:48*	*9/11/2013 19:48*	J2-730	AX-303 benchmark and RSN	2:00:00
DVD-042	*9/11/2013 20:57*	*9/11/2013 22:57*	J2-730	AX-302 and 202 benchmark	2:00:00
DVD-043	*9/11/2013 23:47*	*9/12/2013 1:47*	J2-730	AX-101 Caldera Center and AX-307 Magnesia West	2:00:00
DVD-044	*9/12/2013 1:45*	*9/12/2013 3:45*	J2-730	AX-307 and transit to AX-106	2:00:00

JASON DVD Video List

DVD_Id	Start Date/Time	End Date/Time	Dive	Site	Time Rec
DVD-045	*9/12/2013 3:55*	*9/12/2013 5:55*	J2-730	Ax-106 and transit to AX-308	2:00:00
DVD-046	*9/12/2013 6:05*	*9/12/2013 8:05*	J2-730	AX-308 and transit to AX-106	2:00:00
DVD-047	*9/12/2013 8:03*	*9/12/2013 10:03*	J2-730	AX-106 and AX-307	2:00:00
DVD-048	*9/12/2013 10:02*	*9/12/2013 12:02*	J2-730	AX-101	2:00:00
DVD-049	*9/12/2013 13:27*	*9/12/2013 15:27*	J2-730	Exploring around TREVI and AX-302	2:00:00
DVD-050	*9/12/2013 15:56*	*9/12/2013 17:56*	J2-730	AX-309 to 203/303 benchmark	2:00:00
DVD-051	*9/12/2013 17:54*	*9/12/2013 19:54*	J2-730	AX-203/303 benchmark	2:00:00
DVD-052	*9/12/2013 19:54*	*9/12/2013 21:54*	J2-730	AX-310 benchmark	2:00:00
DVD-053	*9/12/2013 22:25*	*9/13/2013 0:25*	J2-730	AX-104 benchmark-Bag City fluid sampling	2:00:00
DVD-054	*9/13/2013 0:23*	*9/13/2013 2:23*	J2-730	VIXEN and CASPER	2:00:00
DVD-055	*9/13/2013 6:17*	*9/13/2013 8:17*	J2-730	AX-105 and transit to Bag City	2:00:00
DVD-056	*9/13/2013 10:51*	*9/13/2013 12:51*	J2-730	AX-104	2:00:00
DVD-057	*9/13/2013 12:50*	*9/13/2013 14:50*	J2-730	AX-104 amd transit	2:00:00
DVD-058	*9/13/2013 14:48*	*9/13/2013 16:48*	J2-730	Transit to move benchmark AX-303	2:00:00
DVD-059	*9/13/2013 16:46*	*9/13/2013 18:46*	J2-730	AX-303 benchmark and Mkr33 site	2:00:00
DVD-060	*9/13/2013 18:45*	*9/13/2013 20:45*	J2-730	AX-303 to AX-309	2:00:00
DVD-061	*9/13/2013 21:35*	*9/13/2013 23:35*	J2-730	MkrN3 site Fluid sampling MTR 3332	2:00:00
DVD-062	*9/13/2013 23:35*	*9/14/2013 1:35*	J2-730	AX-302 and 202 benchmark and fluid sampling at TREVI	2:00:00
DVD-063	*9/14/2013 1:33*	*9/14/2013 3:33*	J2-730	Spanish Steps Fluid Sampling	2:00:00
DVD-064	*9/14/2013 3:31*	*9/14/2013 5:31*	J2-730	Red Mat samples North of Trevi	2:00:00
DVD-065	*9/14/2013 6:32*	*9/14/2013 8:32*	J2-730	AX-101 and transit to AX-307	2:00:00
DVD-066	*9/14/2013 8:30*	*9/14/2013 10:30*	J2-730	AX-307 and search for lost BPR	2:00:00
DVD-067	*9/14/2013 11:26*	*9/14/2013 13:26*	J2-730	AX106 and APL cap at Virgin	2:00:00
DVD-068	*9/14/2013 13:25*	*9/14/2013 15:25*	J2-730	APL cap at Virgin and AX-308	2:00:00
DVD-069	*9/14/2013 15:23*	*9/14/2013 16:06*	J2-730	Pickup mini-BPR. Finishing up	0:43:00
DVD-070	*9/14/2013 17:29*	*9/14/2013 18:05*	J2-730	Engineering work.	0:36:00
DVD-071	*9/15/2013 0:58*	*9/15/2013 2:58*	J2-731	Begin exploration-transit to Dependable West	2:00:00
DVD-072	*9/15/2013 3:19*	*9/15/2013 5:19*	J2-731	Southeast side of Dependable, Weak and Rusty, Flange	2:00:00
DVD-073	*9/15/2013 5:17*	*9/15/2013 7:17*	J2-731	Trusty, Flange	2:00:00
DVD-074	*9/15/2013 7:15*	*9/15/2013 9:12*	J2-731	Sampling sulfide chimney near gargoyle	1:57:00
DVD-075	*9/15/2013 9:12*	*9/15/2013 11:12*	J2-731	Sampling at Dependable Mound	2:00:00
DVD-076	*9/15/2013 11:12*	*9/15/2013 13:12*	J2-731	Undependable Spire and East of Dependable	2:00:00
DVD-077	*9/15/2013 13:11*	*9/15/2013 14:50*	J2-731	North Dependable	1:39:00
DVD-078	*9/15/2013 20:02*	*9/15/2013 22:02*	J2-732	Trevi Vent Cap moving vent cap, donut, elevator	2:00:00
DVD-079	*9/15/2013 22:00*	*9/16/2013 0:00*	J2-732	Trevi Vent Cap moving vent cap, donut, elevator	2:00:00
DVD-080	*9/16/2013 0:24*	*9/16/2013 2:24*	J2-732	Trevi Vent Cap placement	2:00:00
DVD-081	*9/16/2013 2:22*	*9/16/2013 4:22*	J2-732	Trevi Vent Cap placement	2:00:00
DVD-082	*9/16/2013 4:23*	*9/16/2013 6:23*	J2-732	Trevi Vent Cap and Red Bridges	2:00:00
DVD-083	*9/16/2013 6:21*	*9/16/2013 8:21*	J2-732	2011 Lava Flow	2:00:00
DVD-084	*9/16/2013 8:19*	*9/16/2013 10:19*	J2-732	2011 Lava Flow	2:00:00
DVD-085	*9/16/2013 10:17*	*9/16/2013 12:17*	J2-732	Old Lava	2:00:00
DVD-086	*9/16/2013 12:15*	*9/16/2013 14:15*	J2-732	Caldera Wall	2:00:00

* *DVD recording stopped because of bow thruster issues. Only has 15 min of recording, overlap with disc 8 and 10*

** *No recording for 5-7 min from the moment Jason was at the bottom*

6 - JASON

6.1 Jason Dive Statistics:

Dive	Dates	Max. Depth	Hours Descending	Hours Ascending	Hours on Bottom	Hours in water	Time On Deck	Time on deck not available to science
J2-726	2013/09/05-2013/09/06	1544	1:10	1:21	13:21	15:52	NA	NA
J2-727	9/7/2013	1538	1:06	1:38	14:29	17:13	10:45	4
J2-728	9/8/2013	1528	1:18	1:08	13:43	16:09	7:47	4
J2-729	9/9/2013	1543	1:07	0:55	10:43	12:45	7:49	4
J2-730	2013/09/09-2013-09/14	1543	1:05	1:08	113:47:00	116:00:00	7:26	4
J2-731	2013/09/14-2013-09/15	1993	1:14	1:19	12:57	15:30	4:33	4
J2-732	2013/09/15-2013-09/16	1537	1:00	2:05	17:36	20:41	3:52	
				Total time:	196:36	214:10		

6.2 Jason Dive Summaries

DIVE J2-726 Coquille and ASHES Fluid Sampling

Main goals: Fluid sampling at Vixen and Casper (Coquille vent field), and Virgin, Anemone, and Inferno vents (ASHES vent field)

Samples:
Sample Totals: 33 (24 fluid/6 gas/2 bio)

Tasks Accomplished:
1) Recovered HOBO/MISO 101 (Vixen), HOBO/MISO 141m Casper). HOBO 147 not found at Vixen after extensive looking and excavation.
2) Collected fluid samples at Vixen, Casper, and two nearby diffuse locations to these vents.
3) Conducted pH-H2S-O2-T at Vixen, Casper.
4) Collected syringe microbial sediment sample at Anemone, sediment/mat at Marshmallow and blue mat at Phoenix.
5) Conducted visual survey to assess suitability for APL instrument deployments, and recon area around Vixen/Casper for APL elevator drop target.
6) Recovered HOBO/MISO 129 at Virgin vent
7) Collected fluid samples at Virgin, Anemone, and Inferno and did pH-H2S-O2-Tsurveys.
8) Conducted a visual survey to assess suitability for APL instrument deployments, and recon area around Virgin for APL elevator drop target
9) Recovered MTR temp recorders Medusa (MTR-4098), Anemone (MTR-4099), Fuzzy tubeworm bush (MTR-3040 & 3041), Marshmallow (MTR-3334)and deployed 4 replacements Marshmallow (4097), Fuzzy tubeworm (3043), Anemone (3004) and Hell (3052).
10) Collected suction sample of blue mat
11) Deployed Marker 129 at Anemone..

DIVE J2-727 Installation of Vent Cap at Vixen Vent

Main goals: Deploy vent cap at Vixen vent. After that, as time permits, collect hand-held fluid samples and/or explore 2011 lava flows near Bag City vents.

Samples: none collected

Tasks Accomplished:
1) Located APL elevator.
2) Retrieved vent cap and moved to Vixen.
3) Retrieved and deployed 1 donut from elevator at Vixen vent
4) Moved elevator to vent site.
5) Released (Jason) and recovered (ship) elevator.
6) Positioned second donut and then vent cap on Vixen.
7) Jason positioned sandbags around vent cap at Vixen vent.
8) Jason engineering work (2 hours).

DIVE J2-728 International District Fluid Sampling and RAS deployment

Main goals: High-T and diffuse fluid sampling at International District vent field; deploy RAS instrument at El Gordo vent (Marker 151).

Samples:
Sample Totals: 32 (24 fluid/5 gas/3 bio)

Tasks Accomplished:
1) Located RAS mooring (USBL attached), moved it to El Gordo/Mkr151, Sampled (fluid/gas/ sediment) and temperature measurements at El Gordo/Mkr151. Installed the RAS.
2) Escargot: Fluid sampled, diffuse and hot. Suction sampled blue mat.
3) Diva: Fluid and gas sampled. Recovered HOBO 153 and deployed HOBO 135.
4) El Guapo: Fluid sampled in diffuse flow; syringe sample of mat.
5) Sampled high-T vents at the top of El Guapo, (fluid and hand-held gas sample). Captured video and still images of the top of the structure still flaming.
6) Sampled a high-T vent near the base (just S) of El Guapo (fluid).
7) Castle vent: Recover HOBO. Took 1 gas-tight and 1 fluid sample. Deployed HOBO 103.
8) Located AX-310 and began to move it to its final location (dive ended before complete accomplished).

DIVE J2-729 Installation of vent cap at Virgin Vent

Main goals: Deploy vent cap at Virgin vent.

Samples:
Sample Totals: 8 (3 gas/5 bio)

Tasks Accomplished:
1) Located APL elevator.
2) Moved vent cap from elevator to Virgin vent and set down next to vent.
3) Jason moved elevator with donuts and sand bags over to near Virgin vent. Removed donuts and released elevator, leaving sand bags on bottom.
4) Ship recovered elevator.
5) Jason positioned donut, cap and sandbags at Virgin vent.

6) Collected syringe samples of microbial sediment at Virgin.
7) Collected blue mat from Phoenix.
8) Collected gas-tight samples at Hell (2) and Inferno (2) vents; biology samples at Hell and Inferno.
9) Relocated SCPR mooring

DIVE J2-730 Pressure Measurements at Benchmarks (5-day dive)

Main goals: Make pressure measurements at an array of seafloor benchmarks

Samples:
Sample Totals: 24 (17 fluid/3 gas/3 bio/1 geo)

Tasks Accomplished:
1) Conducted 4 rounds of pressure measurements at seafloor benchmarks, repositioned new benchmarks; released glass floats during daytime benchmark visits which were recovered by ship.
2) Deployed Marker 126 at first visit to AX-310.
3) Jason engineering time to observe the RSN-PN.
4) Deployed Marker 136 at second visit to AX-302/202.
5) Deployed Marker 127 at second visit to AX307.
6) Rock sample at second visit to AX-105 (South Pillow Mound).
7) Fluid sampling at Bag City after third visit to AX-104.
8) Observed vent cap at Vixen.
9) Deployed Marker 128 at Casper. Deployed HOBO 102 and 130 at Capser.
10) Recovered MTR 4095 and deployed MTR 3028 at Mkr 33 site (between AX-310 and AX-303 last visits).
11) Fluid and gas sampled at Marker N3 vent between 4th visit of AX-309. Deployed Marker 135, recovered MTR 3332, deployed MTR 4128 (between last visit of AX-309 and AX-302).
12) After last visit to AX-302/202, Fluid and gas sampled Trevi Vent. Recovered HOBO/MISO 104.
13) Fluid sampled Spanish Steps.
14) Sampled red mat at Red Bridges site; took background water sample.
15) North of Trevi took background water sample and 2 biology samples of red mat at Red Bridges.
16) Searched for lost BPR-middle between last visit to AX-307 and AX-106.
17) Visited SCPR and downloaded some data from device.
18) Observed vent cap at Virgin.
19) Recovered Mini-BPR @ AX-308 after last pressure measurement.

DIVE J2-731 Dependable Vent Field Exploration and Sampling

Main goals: Exploration and sampling of high-T and diffuse fluids in recently discovered field on the SE slope of Axial Seamount. Collect sulfide chimney samples. HD video of vent features. Determine how much of the mound features are sulfide vs. basalt.

Samples:
Sample Totals: 23 (14 fluid/3 gas/2 bio/4 geo)

Tasks Accomplished:
1) Explored terrain south of Dependable West sulfide structure.
2) Sampled diffuse flow (Worm-covered diffuser) on Dependable West south side.
3) Traversed east to south side of Dependable sulfide mound. Took basalt sample from SE side.
4) Explored mound in counter-clockwise direction at 1950 depth until facing due west.
5) Climbed up mound on east side and fluid & gas sampled at Weak & Rusty vent. Deployed Marker 142.
6) Further upslope discovered and fluid & gas sampled flanges near top of NW cone of Dependable.
7) Explored top of mound.
8) Below top fluid/gas sampled high-temperature area of small spires.
9) Sampled good flow area at Trusty. Deployed Marker 141.

10) Explored ‘Alp’ area on Dependable near top.
11) Obtained sulfide sample of flange to right of Marker 141.
12) Explored SE cone of Dependable (inactive) and returned to fluid and bio sample NW cone diffuse area.
13) Backed down Dependable mound into valley between it and SE cone and explored Undependable mound. Took sediment sample NE of Undependable.
14) Explored small, extinct sulfide chimneys as generally drove north to Dependable North structure.
15) Took a basalt and sulfide samples from south face of North Dependable.

DIVE J2-732 Installation of vent cap at Trevi

Main goals: Deploy vent cap at Trevi vent (~8 hrs). After that, the remaining ~12 hrs will be used to explore the northern end of the 2011 lava flows.

Samples:
Sample Totals: 5 (2 bio/3 geo)

Tasks Accomplished:
1) Located APL elevator.
2) Removed vent cap from elevator and placed near vent.
3) Moved elevator to Trevi vent. Deployed donut on vent and installed vent cap on donut.
4) Jason released elevator, ship recovered elevator..
5) Jason positioned sandbags around vent cap, took temperature measurements around vent cap and tubes, and did a video survey of vent.
6) Transited to Red Bridges site. Collected syringe samples of red mat and took rock sample.
7) Deployed Marker 143 at Red Bridges site.
8) Explored flow channel west of Red Bridges and northern end of the 2011 lava. Collected rock samples.

6.3 Dive Maps

Bathymetry data on the dive maps was provided by MBARI and is an AUV bathymetric data compilation through 2011 unless otherwise indicated. Dive navigation tracks were provided at sea by WHOI JASON group from USBL navigation post-processed with WHOI renav process which combines USBL and Doppler positioning. Vent and marker positions have been compiled by the PMEL EOI group for over a decade based on the best information available from bathymetry and site visits over numerous years and vehicles. Sample positions were taken from the best observed position from JASON while sitting in one place (cursor position) for most sampling sites (see the sample tables). Maps are displayed with a UTM zone 9 projection using a GIS. Mooring positions are based on surveys using the WorkBoat software after their deployments except for those instruments which were placed or visited at their final location by Jason.

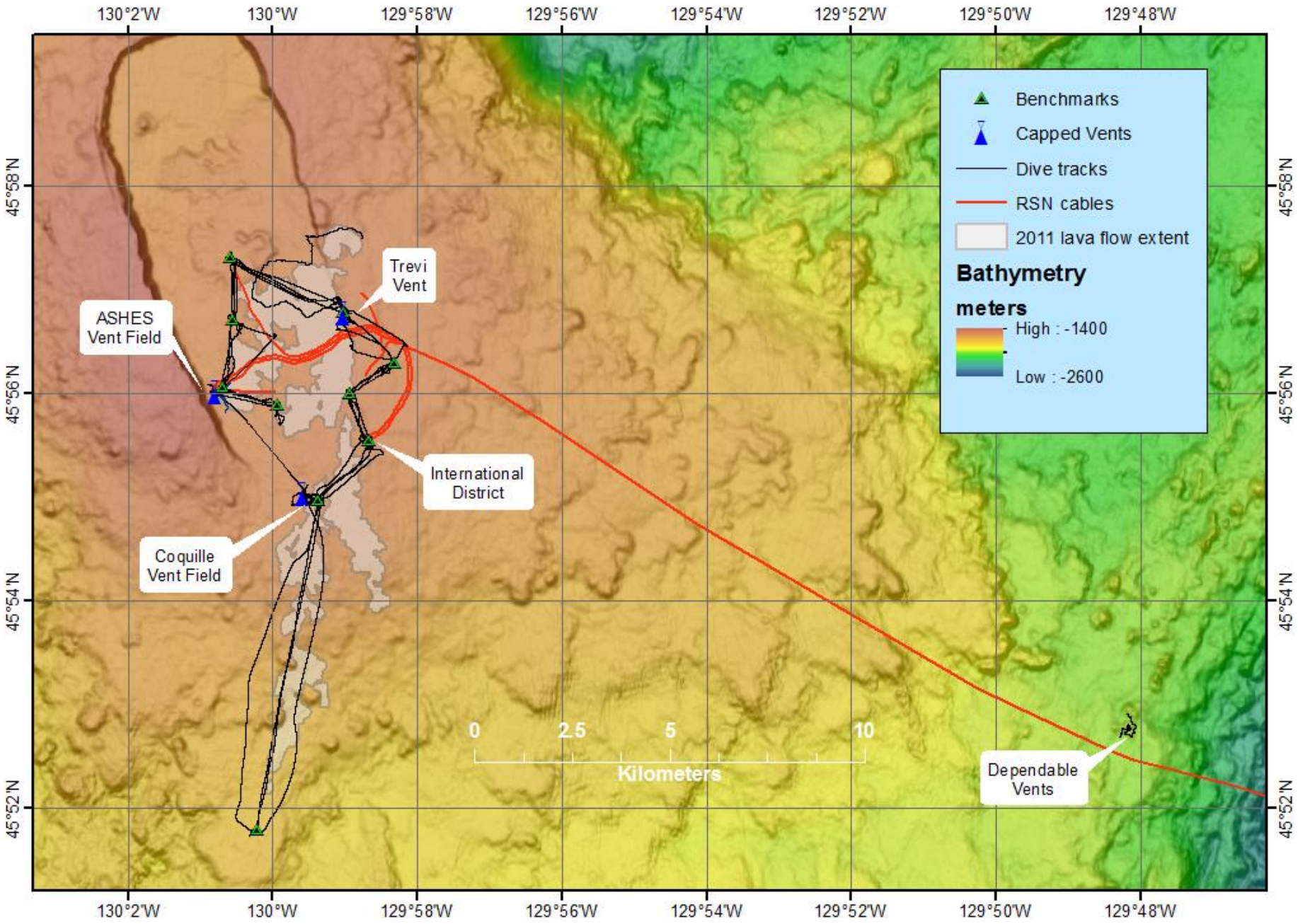


Fig. 6.3-1 Overview of the 2013 expedition dive sites. Bathymetry is from an EM300 data compilation over many years by Susan Merle, gridded at 25 meters.

Fig 6.3-2 Jason dive J2-726 Coquille and ASHES Fluid Sampling. ASHES inset map bathymetry data were shifted +9X/-3Y from the original grids provided by MBARI in 2011 to best fit the vent and marker locations.

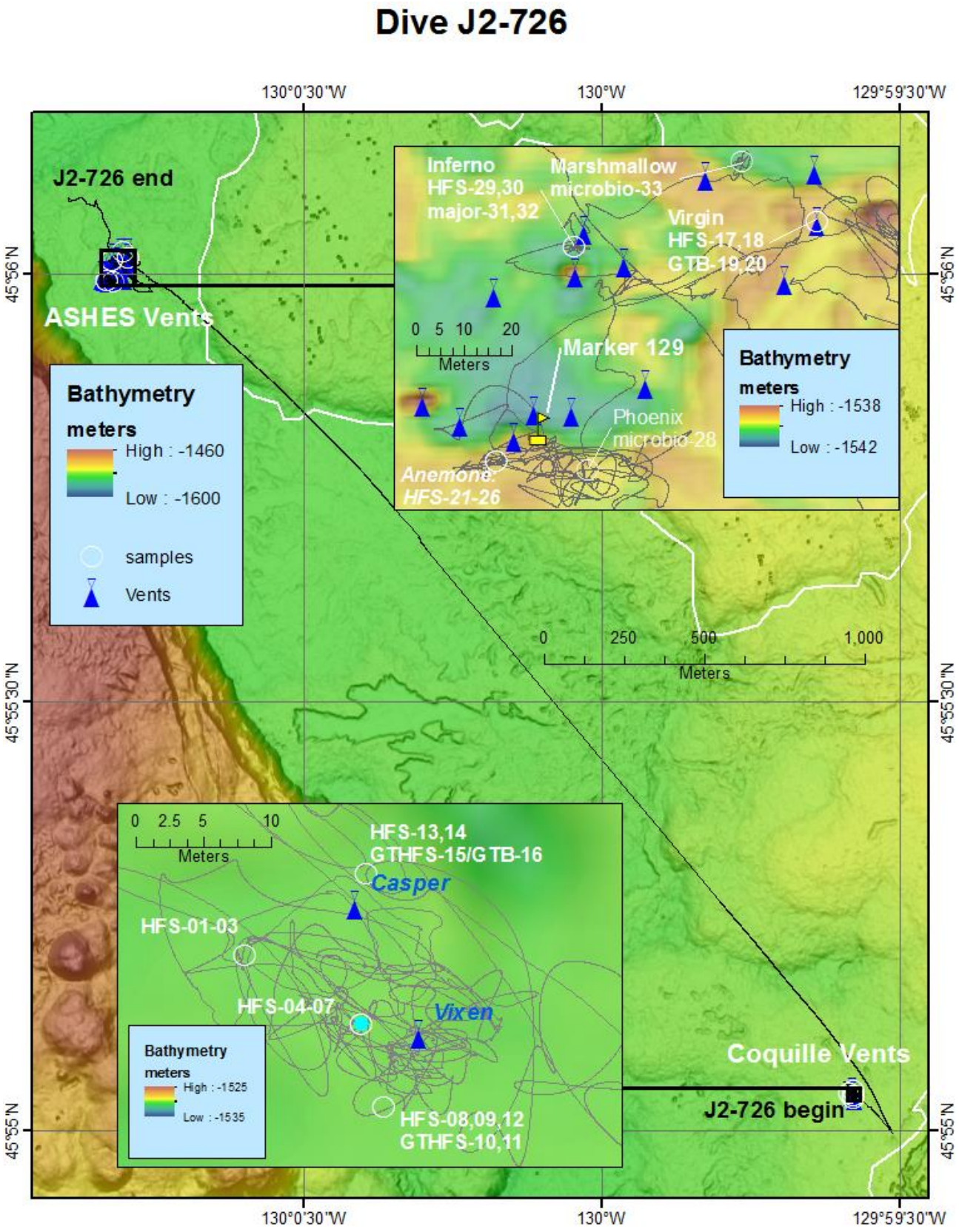


Fig 6.3-3 Jason dive J2-727 Vixen Vent Cap.

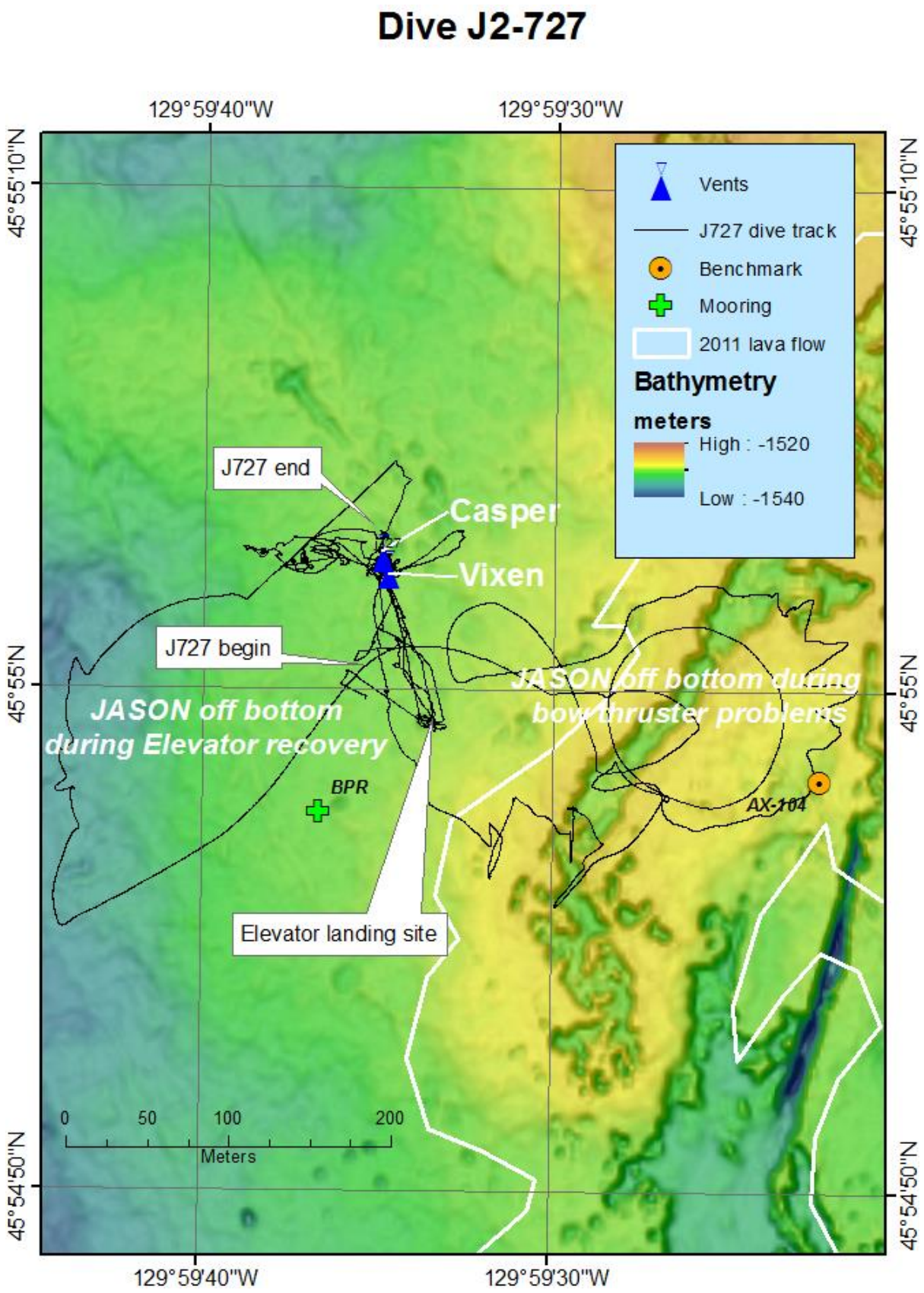


Fig 6.3-4 Jason dive J2-728 International District Fluid Sampling / RAS placement. International District inset map bathymetry data were shifted +9X/-6Y from the original grids provided by MBARI in 2011 to best fit the vent and marker locations.

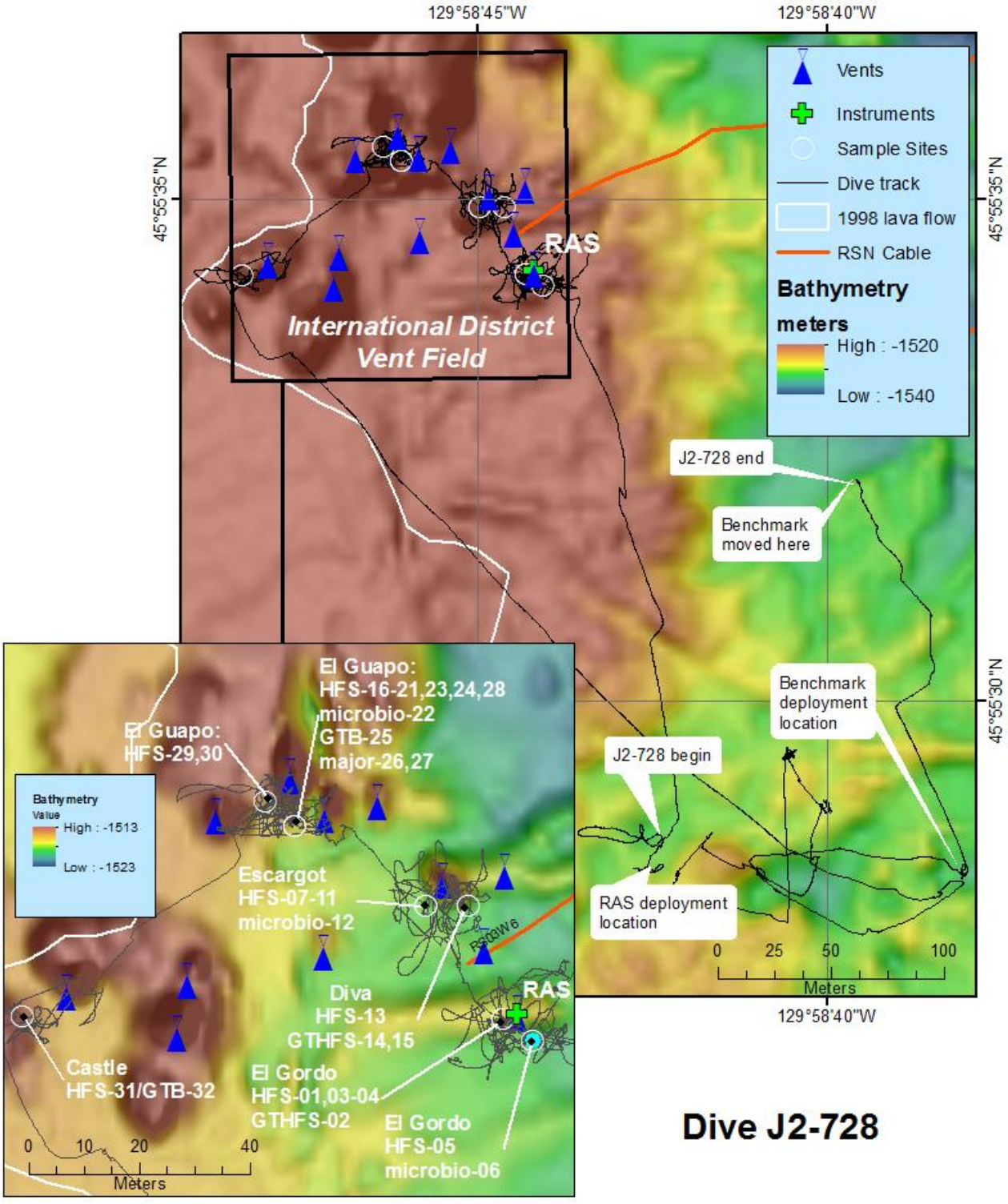


Fig 6.3-5 Jason dive J2-729 ASHES Virgin Vent cap / SCPR Placement. ASHES inset map bathymetry data were shifted +9X/-3Y from the original grids provided by MBARI in 2011 to best fit the vent and marker locations.

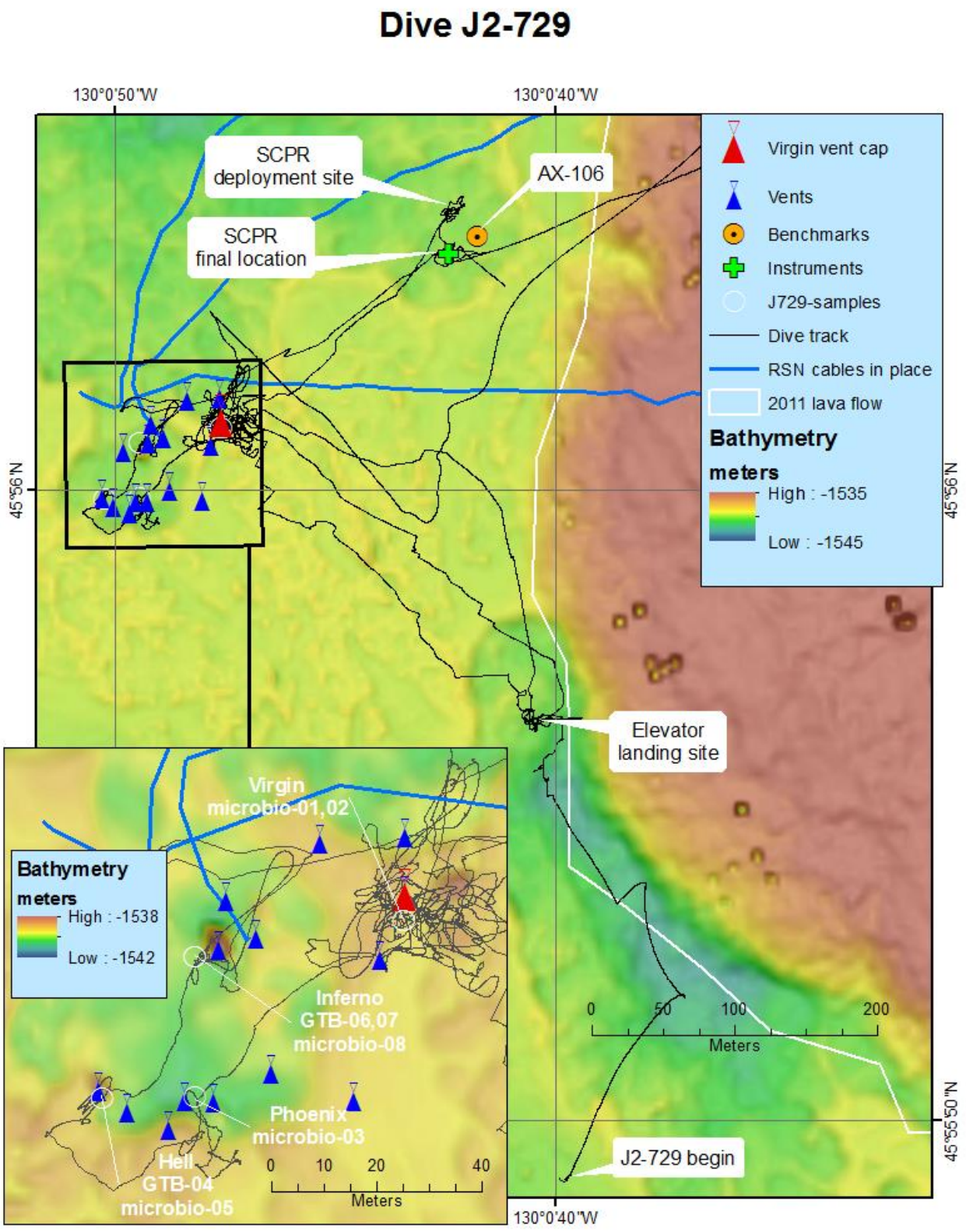


Fig 6.3-6 Jason dive J2-730 Pressure Measurements at Benchmarks**.**

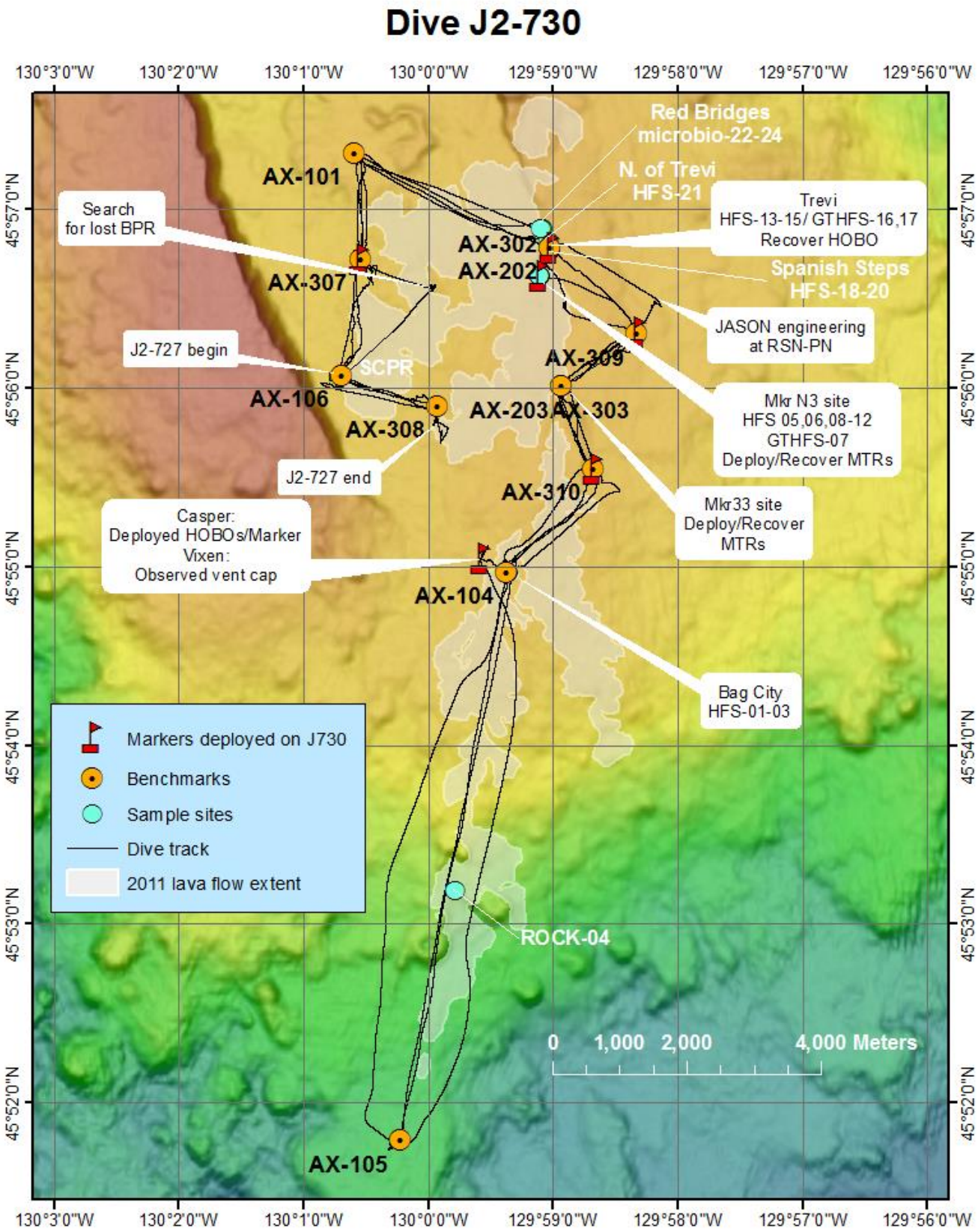


Fig 6.3-7 Jason dive J2-731 Dependable Sulfides Exploration and Sampling. Bathymetry was provided by University of Washington from RSN expedition TN221 (2008) using the Sentry AUV.

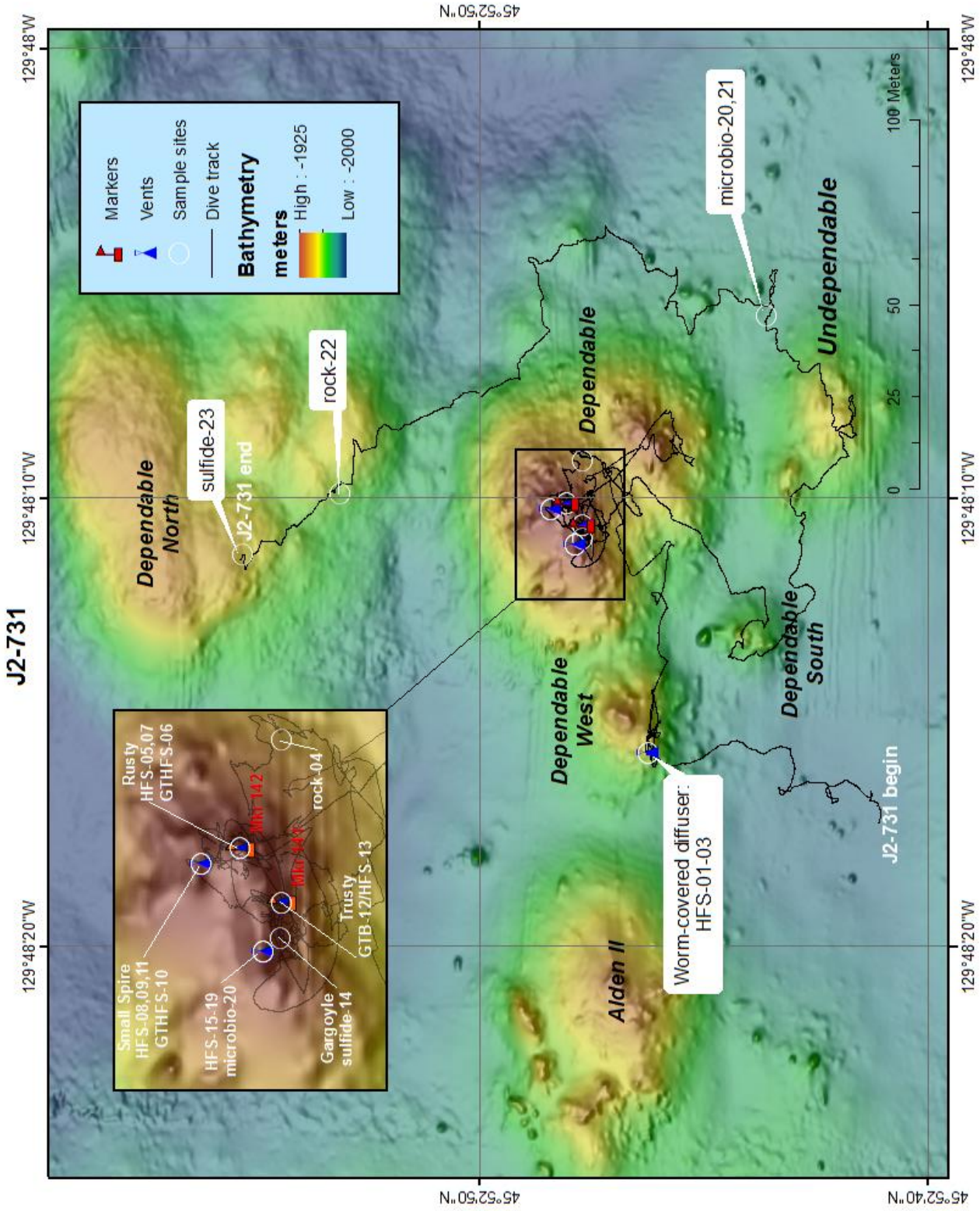
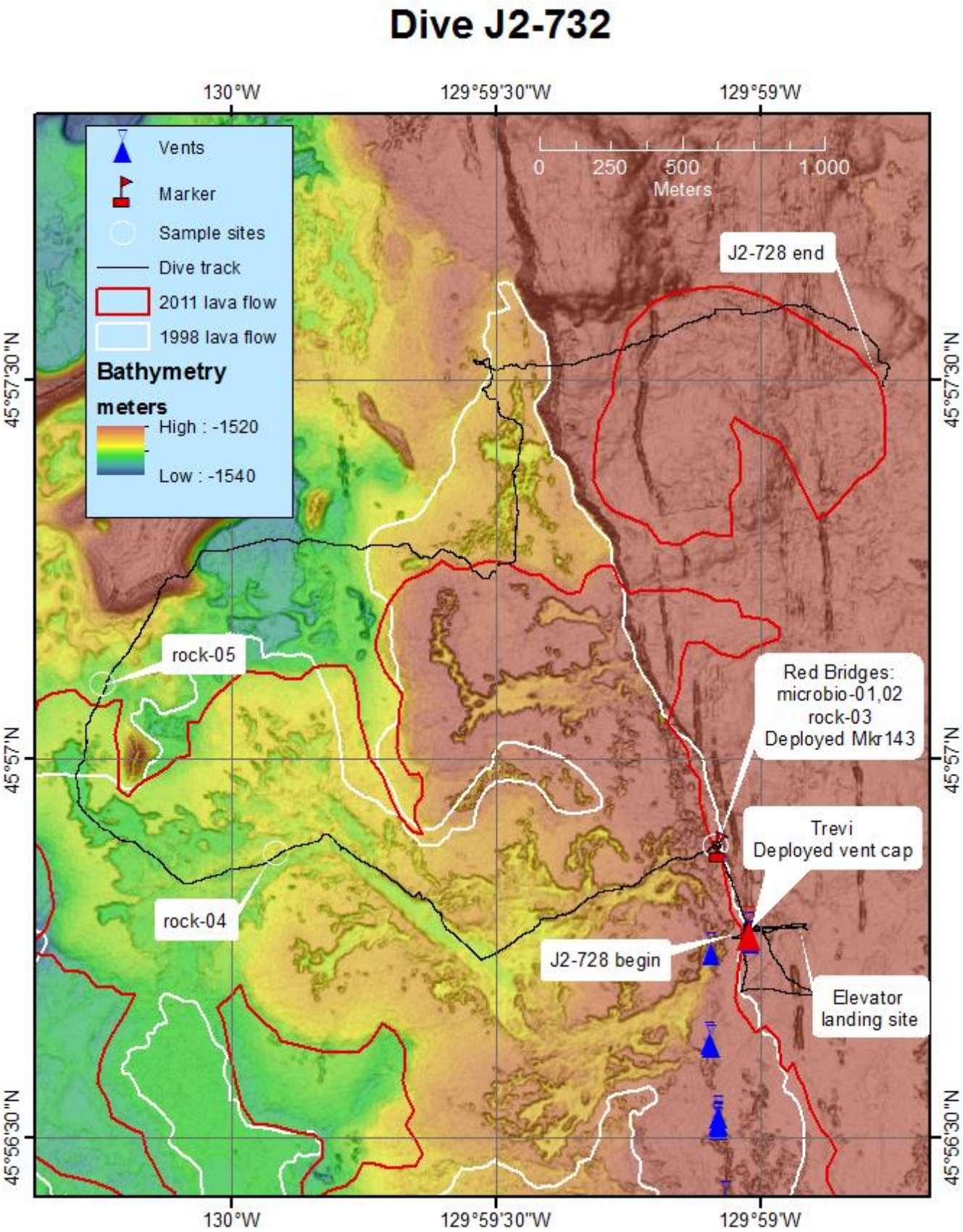


Fig 6.3-8 Jason dive J2-732 Trevi Vent Cap and Exploration of North End 2011 Lava Flow**.**



6.4 Navigation (Markers/Vents)

Andra Bobbitt

Navigation positions for Jason dives in 2013 matched well with previous ROV navigated locations for vents and markers. Positional offsets in the main vent sites (ASHES and International District) were less than 5 meters in X and Y space for most all locations. While sampling in a single area, navigation did drift considerably even after post-processing with Jason RENAV, due to Jason's doppler sonar drifting while the vehicle is stationary on the bottom, giving the false appearance of vehicle movement. Unfortunately, this on-bottom drift is not removed during the Jason RENAV post-processing of the navigation data. Aware of the drift problem during a dive, the data loggers would obtain critical positions (such as sample and instrument locations) by requesting the Jason navigator to place their cursor in the best estimate of the true vehicle location from the scattering of positions displayed on their navigation screen. The latitude and longitude of this 'cursor position' was noted on the logging sheets and used for sample/instrument locations in the cruise report data tables. These 'cursor positions' were used to determine locational offsets between the previous years' positions. The dive maps (section 6.3) of this report displaying Jason's tracklines have not been edited to remove this false drift.

Fig. 6.4-1 Maps showing the Jason's Doppler sonar drifting while the vehicle was stationary during sampling at ASHES (J2-726) and International District (J2-728).

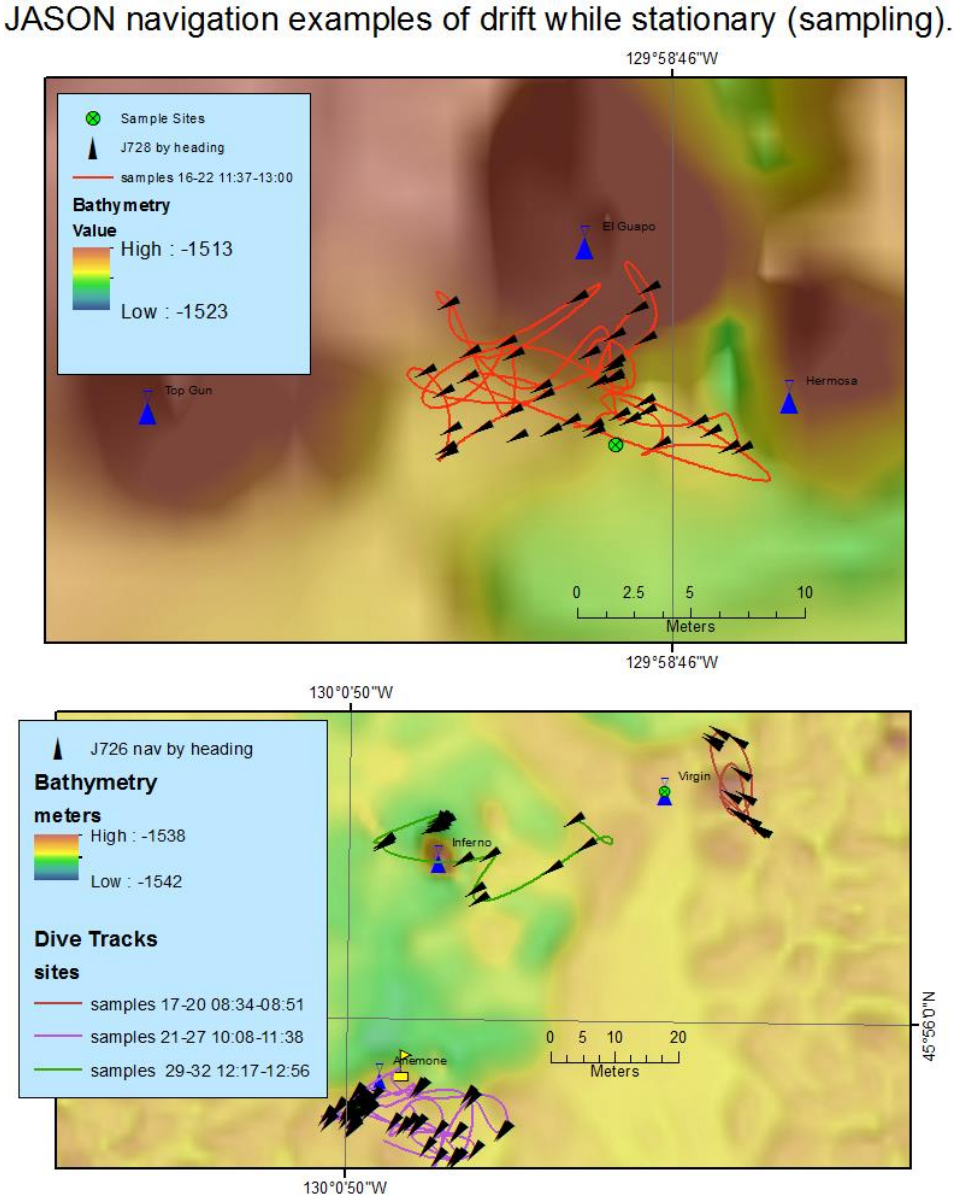


Table 6.4.1 Markers in BOLD were observed during this expedition, remaining markers are listed for reference. Markers listed are sorted by **Area** and then **Marker.**

Marker	Latitude	Longitude	Z	Area	Status	Vent or Benchmark		comments
Mkr135	**45.94370**	**-129.98518**	**1522**	**2011 lava over 98**	**New 2013**	**MkrN3**		**Deployed at post-eruption diffuse MkrN3 site where MTRs were deployed/recovered in 2013. Cursor position. On top of large pillow vv#12253**
Mkr136	**45.94642**	**-129.98379**	**1522**	**2011LavaFlow**	**New 2013**		**AX-302**	**Mrk63 is on old benchmark AX-202 also at this AX-302 site (metal triangle). VV#8714.**
Mkr166	**45.93316**	**-129.98228**	**1520**	**2011LavaFlow**	**ok**	**Marker33 Vent**		**Deployed after 2011 flow. Seen 2013.**
Mkr170	45.92769	-129.98248	1519	2011LavaFlow	ok	Boca		
Mkr63	**45.94639**	**-129.98382**	**1520**	**2011LavaFlow**	**ok**	**Trevi benchmark**	**AX202**	**Attached to metal tripod benchmark that was moved from caldera center to near Trevi vent in 2011.**
Mkr66	**45.93342**	**-129.98228**	**1516**	**2011LavaFlow**	**ok**	**near Marker 33 Vent**	**AX203**	**Attached to metal tripod benchmark that was moved from near AX105 to near Marker33 vent in 2011.**
AX-106	**45.93445**	**-130.01160**	**1542**	**ASHES**	**ok**		**AX-106**	**Cement benchmark AX-106 is ~150 m ENE of ASHES**
Mkr1	**45.93363**	**-130.01358**	**1547**	**ASHES**	**ok**	**Mushroom**		**Deployed 1986 by PiscesIV. Using 2007 vent position.**
Mkr117	45.93331	-130.01334	1546	ASHES		Crack		Marker seen in 1998 (R466)
Mkr121	**45.93355**	**-130.01325**	**1542**	**ASHES**	**ok**	**Gollum**		
Mkr129	**45.93327**	**-130.01374**	**1543**	**ASHES**	**New 2013**	**Anemone**		**Using 2013 sampling/MTR3004 cursor lat/long. VV#1045**
Mkr19	**45.93349**	**-130.01367**	**1547**	**ASHES**	**ok**	**Inferno**		**1998 unreadable due to bio-coating; marker deployed 1996. Spotted 2010 (bucket lid).**
Mkr21	45.93327	-130.01359	1547	ASHES		~5m SW of Styx		
Mkr27	45.93332	-130.01391	1546	ASHES		Hell		Deployed 1986 by PiscesIV. Using 2007 vent position.
Mkr28	45.93328	-130.01362	1547	ASHES		Phoenix		Deployed 1986 by PiscesIV on seafloor. Originally referred to as Hillock Vent. Using 2007 vent position.
Mkr31	45.93363	-130.01358	1547	ASHES		Mushroom		Deployed 1986 by PiscesIV. Using 2007 vent position.
Mkr32	45.93328	-130.01362	1547	ASHES		Phoenix		Deployed 1986 by PiscesIV on side of vent. Originally referred to as Hillock Vent. Using 2007 vent position.

Marker	Latitude	Longitude	Z	Area	Status	Vent or Benchmark		comments
Mkr47	45.93345	-130.01349	1542	ASHES	OK still there 2011	between Gollum-Dave's		
Mkr54	45.93327	-130.01383	1547	ASHES		ROPOS		Deployed 2007 (J2-293) on west edge of ROPOS vent (white diamond)
Mkr64	**45.93356**	**-130.01330**	**1545**	**ASHES**		**Gollum**		
Mkr68	**45.93328**	**-130.01389**	**1542**	**ASHES**		**Medusa-2010**		**Visible 2013 J2-726.**
MkrD	45.93336	-130.01372	1546	ASHES		SE Phoenix		visible J2-293 ('07); nav poor when viewed marker and bucket lid (better when sampling)
MkrI	45.93373	-130.01341	1546	ASHES		Marshmallow		Spotted 2010-1m from vent. Visible J2-293 ('07). Named White Vent originally (R471).
Mrk2	45.93332	-130.01391	1546	ASHES		Hell		Deployed 1986 by PiscesIV on seafloor. Using 2007 vent position.
MrkL	45.93332	-130.01391	1546	ASHES		Hell		Small square foam markers (eyeball) deployed 1998 in hole left by SUAVE sampling. Using 2007 vent position.
observatory platform	**45.93362**	**-130.01389**	**1545**	**ASHES**	**ok**	**West of Inferno**		
Tripod21	45.93357	-130.01329	1547	ASHES	ok	Gollum		
***Hell marker**								***Observed a marker at Hell but did not verify its number. Could be 2/L/27.**
***Inferno marker**								***Observed tiny marker at Inferno but could not read ID. Could be Mkr19.**
Mkr60	**45.95512**	**-130.00989**	**1534**	**CalderaCenter**	**ok**		**AX-101**	**Marker at Caldera Center near AX-101**
Mkr61	**45.95503**	**-130.00989**	**1534**	**CalderaCenter**	**ok**		**AX-101**	**Marker at Caldera Center near AX-101**
Mkr122	45.91717	-129.99290	1534	Coquille		Diffuse vent area		
Mkr128	**45.91745**	**-129.99303**	**1534**	**Coquille**	**New 2013**	**Casper**		**Used Casper position from HOBO 102 deployment. Not a cursor position. VV# 10939**
Mkr57	45.91733	-129.99295	1537	Coquille		Vixen		Deployed 2007. (J2-289) Old mkr57 deployed on R857(04). 2010 repositioned by ~.5m 2007 position over 10m off.
Mkr141	45.87992	-129.80294	**1917**	**Dependable**	**New 2013**	**Trusty**		**Cursor position. Near sampling hole but too hot to place marker anchor in the sampling hole. VV# 15290.**
Mkr142	45.88002	-129.80281	**1919**	**Dependable**	**New 2013**	**Weak & Rusty**		**East side of Dependable. Marker deployed just above the vent sampled; just below and left of a first flange witnessed. Logged nav position (not cursor). VV# 14880.**

Marker	Latitude	Longitude	Z	Area	Status	Vent or Benchmark		comments
Mkr155	**45.94609**	**-129.98365**	**1520**	**E of 1998 & 2011 lava flows (E of Magnesia site)**	**ok**	**Spanish Steps**		**Deployed at new vent (later named Spanish Steps) near Trevi (J2-525). 2013: number not readable.**
Mkr156	45.94628	-129.98371	1520	E of 1998 & 2011 lava flows (E of Magnesia site)	ok	Trevi		Deployed at Trevi (J2-525)
Mkr126	**45.92580**	**-129.97787**	**1531**	**International District**	**New 2013**		**AX-310**	**Using cursor position for location. AX-310 site. VV#7452**
Mkr150	45.92642	-129.97898	1520	International District	ok	Diva		
Mkr151	45.92619	-129.97894	1520	International District	ok	El Gordo		**Could not find marker in 2013.**
Mkr152	45.92655	-129.97937	1517	International District	ok	Hermosa		
Mkr153	45.92650	-129.97920	1517	International District	ok	9m Chimney		
Mkr169	**45.92651**	**-129.97940**	**1519**	**International District**	**ok**	**Hermosa**		**Observed 2013 J2-728.**
MkrN	45.92608	-129.97979	1522	International District	probably gone	Flattop		Not seen 2010. Probably gone.
MkrN5	45.92615	-129.98014	1522	International District	probably gone	Flattop		Didn't see marker in 2007/2010. Gone?
Allison Marker	**45.92608**	**-129.97877**	**1521**	**International District**	**observed in 2013**			**Near El Gordo observed on J2-728 and J2-730. Has a 2010 date on it. Happy Birthday Allison. Mayonnaise container on a rope.**
Marker 12	**45.92572**	**-129.97782**	**1530**	**International District**	**observed in 2013**			**2013: May be something associated with RSN. J730 vv#7362. Near AX-310**
Mkr62	45.92274	-129.98810	1526	Pre-1982 flow (W of 1998 lava)	ok	Mkr113 Vent		Deployed 2007. Site still active (07) but no signs of old marker 113.
Mkr65	**45.91617**	**-129.98950**	**1534**	**Pre-1982 flow (W of 1998 lava)**	**ok**	**Bag City**	**AX-104**	**At Cement benchmark AX-104 near Bag City vent. Survived 2011 eruption.**
Mkr143	**45.94806**	**-129.98465**	**1522**	**Red Mat Bridges**	**New 2013**			**Anchor chain put in red mat surrounded by orange mat near edge of large collapse feature. (Not the sample site which was a nearby pillar). Position from cursor.**
Mkr130	**45.93846**	**-129.97209**	**1527**	**RSN PN**	**New 2013**		**AX-309**	**At RSN Primary Node site and AX-309. Cursor position. VV#7712**
AX-105	**45.86317**	**-130.00375**	**1723**	**SouthPillowMound**	**ok**		**AX-105**	**Cement benchmark AX-105 at S. Pillow Mound site**
Mkr127	**45.94533**	**-130.00913**	**1545**	**West of Magnesia**	**New 2013**		**AX-307**	**Cursor position at AX-307 and Mkr127.**

Marker	Latitude	Longitude	Z	Area	Status	Vent or Benchmark		comments
GhostTrainWheel	45.93208	-129.98407	1519	1998LavaFlow	unknown			Has 1998 date on railroad wheel. Probably old mooring-discovered on R1012-not deployed then. Looks like on edge of 2011 lava flow-not sure if it is still there.
Mkr44	45.92603	-129.98010	1520	1998LavaFlow	probably ok	Village		Sampled on R856 22:45:34. (Added back in 2011-lost off list). Sample R1010 09:17:48.
Smiley marker	45.93326	-129.98178	1517	1998LavaFlow	ok	E of Marker33 vent site		Saw in 2011. It survived the 2011 eruption. Near east edge of 2011 lava flows.
AX-308	45.93160	-129.99880	1533	BPR-South1	**New 2013**			

Table 6.4.2 Vents in BOLD were observed during this expedition, those in bold-italics were observed but not sampled. Remaining vents are listed for reference**.** Vents are sorted by Location then Vent name.

Vent	Latitude	Longitude	Depth	Location	Marker	Type	Comments
Marker33 Vent	45.933200	-129.982268	1524	1998LavaFlow	Mkr166	*diffuse*	Area overrun with 2011 lobate lavas. All markers; RAS; etc. buried. Still some diffuse venting happening. 2011 RAS deployed here. Also Mkr166 and an MTR deployed.
MkrN3 Vent	45.943716	-129.985163	1530	1998LavaFlow	Mkr52	*diffuse*	No previous markers spotted in 2011. Covered in 2011 lava.No blue mat. Still has diffuse flow. No markers.
Village	45.926180	-129.980570	1520	1998LavaFlow	Mkr44	*diffuse*	Not visited in 2010 or 2011. Suspect it is still there post 2011 eruption.
Bag-1	45.916332	-129.989045	1531	2011LavaFlow		*snowblower*	large collapse with large amount of floc coming from snowblower at bottom and pillar is covered in white mat (video highlight)
Bag-2	45.917412	-129.988765	1525	2011LavaFlow		*snowblower*	120 m N of Bag City; big round orifice
Boca	45.927692	-129.982482	1519	2011LavaFlow	Mkr170	*snowblower*	New snowblower vent in 2011 lava. Diffuse snow blower. Rounded shape. Bowl-like.
Cottonball	45.927888	-129.982824	1521	2011LavaFlow		*snowblower*	New vent in 2011 lava. J2-583 traverse to Int'l Dist. Area with white cotton-like mat and orange sediments. NW of Boca Vent.
MBARI-1	45.943873	-129.984953		2011LavaFlow		*snowblower*	snowblower
MBARI-2	45.943813	-129.984906		2011LavaFlow		*snowblower*	snoblower vent from collapsed lobe
MBARI-3	45.940369	-129.984454		2011LavaFlow		*snowblower*	snowblower
MBARI-4	45.924170	-129.982540		2011LavaFlow		*snowblower*	snowblower
Skadi-1	45.923582	-129.982745	1527	2011LavaFlow		*snowblower*	Encountered huge, beautiful snowblower! Looked like the seafloor exploded through the sheet flow. Left marker (“A”) at site. Snow blower "Skadi" - Norse god of snow.
Skadi-2	45.923573	-129.982753	1527	2011LavaFlow		*snowblower*	right next to "Skadi-1" (<1m)
Skadi-3	45.923572	-129.982847	1527	2011LavaFlow		*snowblower*	crack near (~2-3m) Skadi-1 and 2)
Skadi-4	45.923512	-129.982805	1526	2011LavaFlow		*snowblower*	near to Skadi-1 (~3-4 m)
Skadi-5	45.923383	-129.982853	1525	2011LavaFlow		*snowblower*	Big rectangular orifice near (~10 m) Skadi-1.
Snow Globe	45.945844	-129.984892	1521	2011LavaFlow		*snowblower*	Large collapse hole (snowblower) in 2011 lava venting lots of floc and diffuse flow.
Subway	45.942100	-129.984660	1518	2011LavaFlow		*snowblower*	Skylight. A big white hole with a little bit of "lazy floc" and diffuse flow.

Vent	Latitude	Longitude	Depth	Location	Marker	Type	Comments
Subway-1	45.942232	-129.984658	1517	2011LavaFlow		*snowblower*	Snow Blower event for microbial mats R1467_082411_0341_S7
Subway-2	45.942115	-129.984683	1514	2011LavaFlow		*snowblower*	Big orifice; passing over a blizzard blower!
Subway-3	45.942002	-129.984682	1516	2011LavaFlow		*snowblower*	collecting rock sample; placed in the port bio box. bad format for date/time
Anemone	45.933251	-130.013790	1543	ASHES	Mkr129	*diffuse*	Large diffuse venting area at the S end of ASHES field. Less than 10m SW of Phoenix/Ropos sulfide. Anemones and lots of biota present.
Crack	45.933305	-130.013336	1546	ASHES	Mkr117	*diffuse*	Big Johnson (flowmeter) experiment (2001) was deployed here. No venting in 2011 - Marker gone. Marker seen in 1998.
Dave's	45.933523	-130.013829	1547	ASHES		*diffuse*	Very little venting 2011. Believe to be at Dave's in 2010 (no mkr).
Fuzzy Tubeworm Bush	45.933644	-130.013658	1544	ASHES		*diffuse*	Named in 2011. White filamentous bacteria and diverse biota on TW bush. Between Inferno and Mushroom
Gollum	45.933547	-130.013277	1547	ASHES	Mkr121, 64, Tripod21	*diffuse*	Tubeworm bush with diffuse venting. Markers deployed in 2010
Hell	45.933317	-130.013964	1546	ASHES		*sulfide*	Large active sulfide chimney. Marker 68 is 5 m SE. Found on Pisces 1986 dive.
Inferno	45.933561	-130.013674	1547	ASHES		*sulfide*	Large active sulfide chimney. Found on Pisces 1986 dive.
Marshmallow	45.933746	-130.013428	1544	ASHES		*anhydrite*	Small anhydrite vent. Formerly named White Vent (1999 cruise report lists both).
Medusa	45.933280	-130.013894	1547	ASHES	Mkr68	*diffuse*	Mkr-68 is at Medusa. Medusa is just a big tubeworm bush ~5m SE of Hell.
Mushroom	45.933581	-130.013582	1547	ASHES	Mkr1	*sulfide*	Small sulfide vent with tubeworms. Found on Pisces 1986 dive.
Phoenix / Hillock	45.933299	-130.013682	1544	ASHES		*sulfide*	ROPOS11 Jason target. It is actually the position of the small (~2m) sulfide chimney at the S end of ASHES. It looks a bit like a "Phoenix" bird. Originally called Hillock; Verena renamed it Phoenix as it was rising out of the ASHES and grew between 1986-1988.
ROPOS	45.933300	-130.013752	1547	ASHES		*diffuse*	
Styx	45.933350	-130.013541	1544	ASHES	Mkr21 ~5m SW	*diffuse*	Diffuse vent area. This position from 2011 better than previous target. Very little activity in 2011.
Virgin	45.933660	-130.013216	1544	ASHES		*anhydrite*	Anhydrite chimney. Found on Pisces 1986 dive.
Virgin's Daughter	45.933758	-130.013220	1547	ASHES		*anhydrite*	Just north of Virgin - in the general vicinity. Small anhydrites. Still very active in 2006. Pos from Delaney 2010 cruise.

Vent	Latitude	Longitude	Depth	Location	Marker	Type	Comments
Lamphere	45.989337	-130.026562	1576	CASM		*sulfide*	Not active in 1998 R480. Chain placed in 1983 on vent by Tunnicliffe.
Shepherd	45.988868	-130.027200	1580	CASM		*sulfide*	
T&S	45.989153	-130.027168	1583	CASM		*sulfide*	Found 1998.
Casper	45.917414	-129.992989	1538	Coquille		*anhydrite*	Anhydrite chimney, within 10 m of Vixen.
Vixen	45.917327	-129.992946	1537	Coquille	Mkr57	*anhydrite*	Anhydrite chimney within 10 m of Casper vent. Marker laying on ground but noone picked it up. Mkr57? Found 2001. 2007 & 2010 pos within 2m.
Spanish Steps	45.946085	-129.983654	1520	E of 1998 & 2011 lava flows (E of Magnesia site)	Mkr155	*diffuse*	Vent site, tubeworms, and marker still there post-2011 eruption J2-581.
Trevi	45.946276	-129.983713	1520	E of 1998 & 2011 lava flows (E of Magnesia site)	Mkr156	*anhydrite*	Anhydrite chimney. Still there in 2011 after eruption. Mkr63 at AX202 benchmark. Discovered in 2007.
OldFlow	45.936447	-129.981705	1522	E of 1998 & 2011 lava flows (N of Cloud site)		*diffuse*	Just east of the '98 flow in older lava. North of Nascent and Mkr N41. Last visited in 2001 for tubeworm grab. Large old flow area on the edge of the '98 flow.
9m Chimney	45.926536	-129.979273	1518	International District	Mkr153	*sulfide*	2010 nav from bathy & J523 nav. (Mkr153 deployed 2010)
Castle	45.926218	-129.979996	1518	International District		*anhydrite*	Active anhydrite vent at base of large dead sulfide chimney.
Diva	45.926424	-129.978975	1524	International District	Mkr150	*anhydrite*	Anhydrite chimney. 2010 nav from bathy & J523 nav. (Mkr150 deployed 2010)
El Abuelo	45.926241	-129.979715	1516	International District		*sulfide*	Extinct sulfide chimney. 2010 nav from bathy & J523 nav.
El Antiguo	45.926288	-129.979396	1521	International District		*sulfide*	Extinct sulfide chimney. 2010 nav from bathy & J523 nav.
El Gordo	45.926194	-129.978939	1524	International District	Mkr151	*diffuse*	Tubeworm bush. 2010 nav from bathy & J523 nav. (Mkr151 deployed 2009-Alvin)
El Guapo	45.926575	-129.979479	1507	International District		*sulfide*	Large active sulfide chimney. 2010 nav from bathy & J523 nav.
Escargot	45.926409	-129.979119	1520	International District		*sulfide*	Active sulfide chimney. 2010 nav from bathy & J523 nav.
Flattop	45.926154	-129.979735	1522	International District		*sulfide*	Extinct sulfide chimney near Castle. 2010 nav from bathy & J523 nav. (Mkr N5 not seen 2010)
Hermosa	45.926514	-129.979398	1519	International District	Mkr152	*sulfide*	Large active sulfide chimney. 2010 nav from bathy & J523 nav (Mkr152 deployed in 2010)
Tiny Towers	45.926303	-129.979022	1524	International District		*sulfide*	Mini chimneys. 2010 nav from bathy & J523 nav.

Vent	Latitude	Longitude	Depth	Location	Marker	Type	Comments
Top Gun	45.926510	-129.979652	1520	International District		*sulfide*	Large inactive sulfide chimney. 2010 nav from bathy & J523 nav.
91 Vent	46.038600	-130.012420		NorthRiftZone			May be the same as Bob Vent.
Bag City vent	45.916338	-129.989153	1536	Pre-1982 flow (W of 1998 lava)	Mkr36	*diffuse*	Marker and old NeMONet frame not found in 2011.
Bag City	45.91617	-129.98950	1534	Pre-1982 flow (W of 1998 lava)	Mkr65	*diffuse*	HFS sample site in 2013. Near original Bag City vent at the AX-104 benchmark at edge of collapse.
Mkr113 Vent	45.92274	-129.988104	1526	Pre-1982 flow (W of 1998 lava)	Mkr62	*diffuse*	Not visited 2011 post-eruption. Believe it is still there. Marker 62 at site. Vent still very active venting on top and under pillar.
Worm-covered diffuser	45.879512	-129.804358	1941	Dependable West		*diffuse*	Discovered 2013 by RSN cruise. Sampled Axial2013. Hdg. 039. VV# 14450.
Weak & Rusty	45.88002	-129.80281	1919	Dependable	Mkr142	sulfide	Discovered 2013 by RSN cruise. Sampled Axial2013. Hdg. 254. VV# 14880.
Trusty	45.87992	-129.80294	1917	Dependable	Mkr141	sulfide	Discovered 2013 by RSN cruise. Sampled Axial2013. Hdgs 179. VV# 15290.
Small Spires	45.880117	-129.80285	1919	Dependable		*sulfide*	Hdg. 181. Above and to the right of a flange (further right from the Mkr142).
Broken Spire	45.879965	-129.803063	1914	Dependable		*sulfide*	Diffuse flow near a broken chimney to left of Mkr141. Hdg is 068. VV# 15728.

6.5 JASON Samples

125 total samples were collected by JASON on this expedition. The samples were composed of 79 fluid, 20 gas, 18 biology and 8 geology samples.

Table 6.5.1 Samples

J2-726 Samples

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J726-HFS-01	fluid	3m SW of Casper	Diffuse flow in skinny tubeworms and lots of limpets; palm worms and a few anemones.	Large volume bag (LVB) Filtered bag #24. O2 (oxygen) 26C. Oxygen level is 0182 mL/L. pH voltage is 3.334. Tmax=30.6 Tavg=28.5 T2= Vol=4003mL.	Butterfield	9/6 01:35	45° 55.0428'N	129° 59.5838'W	1534	64.1	214
J726-HFS-02	fluid			Filtered bag #22. T max=26.2 Tavg=26.0 T2=16. Vol=650mL.	Butterfield	9/6 01:56	45° 55.0428'N	129° 59.5838'W	1534	64.09	222
J726-HFS-03	fluid			RNA filter #14. Tmax=26.3 Tavg= 25.1 T2= 15.7. Vol=3003mL.	Butterfield	9/6 01:59	45° 55.0428'N	129° 59.5838'W	1534	64.09	227
J726-HFS-04	fluid	~3m W/NW of Vixen	Vigorous diffuse flow with healthy tubeworms; limpets and palmworms.	Filtered bag #18. Tmax=34.1 Tavg=33.9 T2= 21 Vol= 602 mL. pH voltage = 3.181. Oxygen = 0.103mL/L.	Butterfield	9/6 02:29	45° 55.04'N	129° 59.5791'W	1533	128.03	279
J726-HFS-05	fluid			Unfiltered bag #19. Tmax= 34.2 Tavg= 34.0 T2=21. Vol=600mL. pH voltage = 3.181. Oxygen = 0.103mL/L.	Butterfield	9/6 02:35	45° 55.04'N	129° 59.5791'W	1533	128.04	301
J726-HFS-06	fluid			RNA filter #10. Sample may have leaked. Tmax=34.2 Tavg=33.9 T2=21.3. Vol=3000 mL. pH voltage = 3.181. Oxygen = 0.103mL/L.	Butterfield	9/6 02:41	45° 55.04'N	129° 59.5791'W	1533	128.04	312
J726-HFS-07	fluid			RNA filter #11. Sample may have leaked. Tmax= 33.9 Tavg= 33.7 T2= 21.0 Vol=3000mL. pH voltage = 3.181. Oxygen = 0.103mL/L.	Butterfield	9/6 02:57	45° 55.04'N	129° 59.5791'W	1533	128.06	363
J726-HFS-08	fluid	Vixen	Knocked down chimney and sampling directly in the intense flow.	Filtered piston #2 (PF2). Tmax= 333.3 Tavg=319.3 T2= 80 Vol=400 mL. Jason temp probe 344°C	Butterfield	9/6 03:42	45° 55.0367'N	129° 59.5782'W	1534	127.69	459
J726-HFS-09	fluid			Unfiltered piston #3. Tmax= 333.6 Tavg=330.8 T2=80. Vol=400mL. Jason temp probe 344°C.	Butterfield	9/6 03:44	45° 55.0367'N	129° 59.5782'W	1534	127.75	462
J726-GTHFS-10	gas			Port HFS gastight. T=326. Jason temp probe 344°C.	Evans	9/6 03:47	45° 55.0367'N	129° 59.5782'W	1534	127.66	468

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J726-GTHFS-11	gas			Center HFS gastight. T=330. Jason temp probe 344°C.	Evans	9/6 03:48	45° 55.0367'N	129° 59.5782'W	1534	127.65	471
J726-HFS-12	fluid			Unfiltered bag #17. Sample for gold. Tmax=334.9 Tavg= 320.0 T2= 80 Vol= 300mL.	Butterfield	9/6 03:56	45° 55.0367'N	129° 59.5782'W	1534	127.63	485
J726-HFS-13	fluid	Casper	Knocked down chimney and sampling directly in the intense flow.	Filtered piston #4. Tmax=249.8 Tavg=247 T2=30.2 Vol=402mL. Jason temp probe 314°C.	Butterfield	9/6 05:29	* 45° 55.0461'N	129° 59.5789'W	1534	152.14	629
J726-HFS-14	fluid			Unfiltered piston #5. Tmax= 252.9 Tavg=241 T2= 9 Vol= 402 mL. Jason temp probe 314°C.	Butterfield	9/6 05:33	* 45° 55.0461'N	129° 59.5789'W	1534	151.65	634
J726-GTHFS-15	gas			Stbd HFS gastight. Tmax-310 T2=76. (NOTE: Ram did not move but think sample did fire). Jason temp probe 314°C.	Evans	9/6 05:48	* 45° 55.0461'N	129° 59.5789'W	1534	156.11	655
J726-GTB-16	gas			Green gastight bottle #2. Jason temp probe 314°C.	Evans	9/6 05:59	* 45° 55.0461'N	129° 59.5789'W	1534	156.24	678
J726-HFS-17	fluid	Virgin	Chimney fell over. Sampling directly in the intense flow.	Filtered piston #8. Jason T probe 271.8. Tmax=265.2 T2= 90.7 Vol=411mL. (sample pump stopped and restarted during sample a couple of times.)	Butterfield	9/6 08:34	* 45° 56.0119'N	130° 0.7859'W	1544	301.56	762
J726-HFS-18	fluid			Unfiltered piston #9. No good HFS temperature readings. (Same position as sample #17). Jason T probe 271.8.	Butterfield	9/6 08:41	* 45° 56.0119'N	130° 0.7859'W	1544	301.62	773
J726-GTB-19	gas			Red/green gastight bottle #7. Jason T probe 271.8.	Evans	9/6 08:46	* 45° 56.0119'N	130° 0.7859'W	1544	301.66	781
J726-GTB-20	gas			Nude gastight bottle #11. Tried to fire twice becasue the ram wasn't properly positioned the first time. Jason T probe 271.8.	Evans	9/6 08:51	* 45° 56.0119'N	130° 0.7859'W	1544	301.63	788
J726-HFS-21	fluid	Anemone	Small area of diffuse flow with biota(short fat tubeworms; anemones; limpets; palmworms)	Large Volume Bag (LVB) collection #1. 28C. Tmax=30.6 Tavg=28.5 T2=16.2 Vol=4003 mL.	Butterfield	9/6 10:08	* 45° 55.9924'N	130° 0.8295'W	1543	218.68	909
J726-HFS-22	fluid			Filtered bag #20. Tmax=29.1 Tavg=28.2 T2=15.3 Vol=651 mL.	Butterfield	9/6 10:32	* 45° 55.9924'N	130° 0.8295'W	1543	218.83	945
J726-HFS-23	fluid			Unfiltered bag #21. Tmax=30.9 Tavg=-29.2 T2 16.4 Vol=651mL.	Butterfield	9/6 10:36	* 45° 55.9924'N	130° 0.8295'W	1543	218.84	952
J726-HFS-24	fluid			Unfiltered bag #23. Pump stopped and restarted during sample (probe moved) Tmax=35.9 Tavg=34.3 Vol=663mL. Log states only 250 mL in bag when pump stopped.	Butterfield	9/6 10:42	* 45° 55.9924'N	130° 0.8295'W	1543	218.65	965

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J726-HFS-25	fluid			RNA filter #15. Pump lost power and probe drifted out of vent flow. Started flush pum and reinserted probe. Tmax=35.8 Tavg=34.4 T2=n/a Vol=1924mL.	Butterfield	9/6 10:52	* 45° 55.9924'N	130° 0.8295'W	1543	218.64	973
J726-HFS-26	fluid			RNA filter #16. Tmax=56.9 Tavg=54.6 T2=25.9 Vol=3002 mL. O2=0.325 mL/L.	Butterfield	9/6 11:08	* 45° 55.9924'N	130° 0.8295'W	1543	217.74	985
J726-microbio-27	bio			Large green syringe sample in sediment near previous Anemone samples.	Vining	9/6 11:38	* 45° 55.9924'N	130° 0.8295'W	1542	217.62	1038
J726-microbio-28	bio	Phoenix	Sulfide chimney with biota including blue mat.	Biofilm - suction sample of blue mat on lower portion of Phoenix sulfide chimney. Large amount of blue mat in the chamber.	Vining	9/6 11:48	* 45° 55.9913'N	130° 0.8191'W	1543	350.41	1063
J726-HFS-29	fluid	Inferno	Sulfide chimney. Same spire as last year. 3+ m up the chimney.	Spire has good flow.Filtered piston #6. Tmax=300.1 Tavg=299.6 T2=80 Vol=600mL. Tmax=311.3 with Jason temp probe.	Butterfield	9/6 12:17	* 45° 56.0167'N	130° 0.8206'W	1540	237.61	1140
J726-HFS-30	fluid			Unfiltered piston #7. Both pumps stopped so sample restarted at 1225. Tmax=300.3 Tavg=300 T2=78 Vol=657mL. Tmax=311.3 with Jason temp probe.	Butterfield	9/6 12:25	* 45° 56.0167'N	130° 0.8206'W	1540	237.26	1150
J726-Major-31	fluid			White major sampler. Tmax=300.3. Tmax=311.3 with Jason temp probe.	Butterfield	9/6 12:38	* 45° 56.0167'N	130° 0.8206'W	1540	237.7	1167
J726-Major-32	fluid			Yellow major sampler. Tmax=311.3 with Jason temp probe.	Butterfield	9/6 12:56	* 45° 56.0167'N	130° 0.8206'W	1539	259.03	1208
J726-microbio-33	bio	Marshmallow	From the middle of small tubeworm clump.	Small white syringe sample of mixture of sediment and mat.	Vining	9/6 13:27	* 45° 56.0264'N	130° 0.8015'W	1542	289.66	1280

J2-727 Note: No samples were taken on J2-727

J2-728 Samples

J728-HFS-01	fluid	El Gordo	In healthy tube worm clump (mid-level) on the active side (N) of the vent.	Filtered bag #18. Tmax=62.9 Tavg= 61.3 T2=30.0. Vol= 610mL	Butterfield	9/8 05:40	45° 55.5711'N	129° 58.7384'W	1521	182.45	2643
J728-GTHFS-02	gas	El Gordo	In the same worm clump as the first sample but slightly different location. Still N side of vent.	Starboard red-9 GTHFS. T2=64 Tmax=156.	Evans	9/8 05:53	45° 55.5711'N	129° 58.7384'W	1521	177.33	2668

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J728-HFS-03	fluid	El Gordo	Steady flow at base of a few healthy tube worms. Still N side of vent.	RNA filter #10. Tmax=77.3 Tavg= 76.0 T2=35. Vol=3000mL.	Butterfield	9/8 06:03	45° 55.5711'N	129° 58.7384'W	1521	176.14	2714
J728-HFS-04	fluid			RNA Filter #11. Tmax=78.8 Tavg=77.4 T2=34. Vol=3000mL.	Butterfield	9/8 06:21	45° 55.5711'N	129° 58.7384'W	1521	176.13	2739
J728-HFS-05	fluid	El Gordo	Sample from one of the RAS vent cap holes.	Unfiltered bag #19. Tmax=59.1C Tavg=58.8C T2=26C Vol=629mL. Placed the beast nozzle in the vent cap. T1= 54.1C O2= 0.336 mL/L.	Butterfield	9/8 07:46	45° 55.569'N	129° 58.7342'W	1521	168.94	2905
J728-microbio-06	bio	El Gordo	Just underneath a dead tubeworm bush at the top of the vent. A few feet from the RAS vent cap.	Large green syringe of sediment for microbiological studies. The dark material is a solid crust and the white material is a light colored sediment not mat.	Vining	9/8 07:57	45° 55.569'N	129° 58.7342'W	1520	168.54	2927
J728-HFS-07	fluid	Escargot	In the middle of a limpet pile on the "shelf" in very diffuse flow ~2/3 of the way up the chimney.	Filtered bag #22. Tmax=6.6C Tavg=6.5C T2=4.3C Vol=627 mL. O2= 0.327mL/L	Butterfield	9/8 08:30	45° 55.5821'N	129° 58.7494'W	1519	285.63	3023
J728-HFS-08	fluid			Filtered bag #24. Tmax=6.5C Tavg=6.4C T2=4.3C Vol=626mL. O2= 0.327mL/L	Butterfield	9/8 08:34	45° 55.5821'N	129° 58.7494'W	1519	285.63	3023
J728-HFS-09	fluid			RNA filtered bag #d14. Tmax=6.7C Tavg=6.5C T2=4.4C Vol=3001mL. O2= 0.327mL/L.	Butterfield	9/8 08:41	45° 55.5821'N	129° 58.7494'W	1519	286.14	3040
J728-HFS-10	fluid	Escargot	Top of chimney in area of broken off anhydrite spire.	Filtered piston #8. Tmax=264.1 Tavg= 262.1 T2= 73.0 Vol=503mL.	Butterfield	9/8 09:21	45° 55.5821'N	129° 58.7494'W	1517	292.38	3134
J728-HFS-11	fluid			Unfiltered piston #9. Tmax=265.7C Tavg=263.1C T2=70.0C Vol=501 mL.	Butterfield	9/8 09:25	45° 55.5821'N	129° 58.7494'W	1517	292.81	3141
J728-microbio-12	bio	Escargot	East side of the chimney. Blue patch with a streak of limpets going through the middle.	Most likely some warm flow here because of the limpets. Suction of blue mat.	Vining	9/8 09:36	45° 55.5821'N	129° 58.7494'W	1520	83.84	3175
J728-HFS-13	fluid	Diva	Hole at the top of the anhydrite mound that used to be the spire base.	Filtered piston #2. Tmax=271.5 Tavg=271.2 T2=77.8 Vol=201 mL.	Butterfield	9/8 09:55	45° 55.5822'N	129° 58.7435'W	1522	65.89	3235
J728-GTHFS-14	gas			GTHFS port purple-10. Temp has dropped significantly; now about 200C. The flush pump had shut off.	Evans	9/8 10:00	45° 55.5822'N	129° 58.7435'W	1522	65.89	3235
J728-GTHFS-15	gas			GTHFS center orange-16. Tmax= 270.7C.	Evans	9/8 10:05	45° 55.5822'N	129° 58.7435'W	1522	65.85	3255
J728-HFS-16	fluid	El Guapo	In diffuse flow on NE side of chimney 5m up.	Filtered bag #20. Volume Tmax 23.9C Tavg 23.8C T2 11.3C. 626mL.	Butterfield	9/8 11:37	45° 55.5897'N	129° 58.768'W	1515	242.2	3433
J728-HFS-17	fluid			Unfiltered bag #21. Tmax=24.9 Tavg=23.8 T2-11.8. Vol=629mL.	Butterfield	9/8 11:41	45° 55.5897'N	129° 58.768'W	1515	242.11	3439

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J728-HFS-18	fluid			Unfiltered bag #23. Tmax=25.7 Tavg=25.2 T2=12.0. Vol=629mL. O2=0.398 ml/L.	Butterfield	9/8 11:45	45° 55.5897'N	129° 58.768'W	1515	242.01	3447
J728-HFS-19	fluid			Large volume bag (LVB) #1. Vol=4002 mL. Tmax=26.1 Tavg=24.2. T2=11.9.	Butterfield	9/8 11:54	45° 55.5897'N	129° 58.768'W	1515	241.77	3461
J728-HFS-20	fluid			RNA filter #15. Tmax=25.9 Tavg=24.2 T2=11.7. Vol=3001 mL.	Butterfield	9/8 12:13	45° 55.5897'N	129° 58.768'W	1515	241.76	3500
J728-HFS-21	fluid			RNA filter #16. Tmax=25.7 Tavg=24.6 T2=11. Vol=3023mL. 0.3mL/L. pH voltage = 3.024	Butterfield	9/8 12:29	45° 55.5897'N	129° 58.768'W	1515	242.15	3521
J728-microbio-22	bio			Big white syringe sample of brownish mat/biology and anything that gets in there.	Vining	9/8 13:00	45° 55.5897'N	129° 58.768'W	1515	242.43	3563
J728-HFS-23	fluid	El Guapo	In direct flow at "boiling flaming" orifice at top of chimney. 14 m off seafloor. Facing SW.	Filtered piston #4. T=336 at start. Tmax=338.1 Tavg=332 T2=80. Vol=455mL.	Butterfield	9/8 13:22	45° 55.5897'N	129° 58.768'W	1504	246.81	3663
J728-HFS-24	fluid			Unfiltered piston #5. Tmax=339.2 Tavg=326 mL T2~100. Vol=451. Good sample even though the pump was not happy. Actual Tmax was probably 346C. Jason temp reading is 342C after the sample.	Butterfield	9/8 13:27	45° 55.5897'N	129° 58.768'W	1504	247.92	3673
J728-GTB-25	gas			J728-GTB-25 blue-12. Fired in the same orifice as the HFS samples.	Evans	9/8 13:38	45° 55.5897'N	129° 58.768'W	1504	247.47	3699
J728-Major-26	fluid			White major sampler.	Butterfield	9/8 13:45	45° 55.5897'N	129° 58.768'W	1504	247.34	3714
J728-Major-27	fluid			Yellow major sampler.	Butterfield	9/8 13:49	45° 55.5897'N	129° 58.768'W	1504	247.63	3725
J728-HFS-28	fluid			Unfiltered bag #17. Tmax=334.8 Tavg=307 T2=75. Vol=400 mL.	Butterfield	9/8 13:57	45° 55.5897'N	129° 58.768'W	1504	247.95	3741
J728-HFS-29	fluid	El Guapo	Area of venting from tiny black beehives with dense biota. 9 meters up the chimney facing SE.	Filtered piston #6. Tmax=63..3 Tavg=58 Voll=600mL. T2=22.	Butterfield	9/8 14:25	45° 55.5921'N	129° 58.7721'W	1507	146.09	3849
J728-HFS-30	fluid			Unfiltered piston #7. Tmax=56.1 Tavg=54.1 T2=22. Vol=600mL. Oxygen=0.293 mL/L. pH voltage=2.809.	Butterfield	9/8 14:30	45° 55.5921'N	129° 58.7721'W	1507	146.03	3856
J728-HFS-31	fluid	Castle	On ledge near the base in area where the anhydrite chimney was just knocked over and excavated.	Unfiltered piston #3. Tmax= 271.6 Tavg=266 T2=93. Vol=253mL.	Butterfield	9/8 15:22	* 45° 55.5708'N	129° 58.8059'W	1516	26.36	3977
J728-GTB-32	gas			White -17 gastight bottle directly in the orifice where the previous 271deg sample was taken.	Evans	9/8 15:31	* 45° 55.5708'N	129° 58.8059'W	1516	27.8	3999

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J2-729 Samples											
J729-microbio-01	bio	Virgin	Excavated anhydrite mound.	Big white syringe sample of sediment consisting of the anhydrite leveled off when the APL instrument was deployed. Not sure that sample was successful.	Vining	9/9 11:31	* 45° 56.0165'N	130° 0.7931'W	1542	52.58	5095
J729-microbio-02	bio			Big green syringe sample of sed/anhydrite area around vent excavated for APL termal experiment.	Vining	9/9 11:35	* 45° 56.0165'N	130° 0.7931'W	1542	125.73	5115
J729-microbio-03	bio	Phoenix	~2/3 up sulfide chimney with dense biota.	Suction sampled blue mat on older; cooler (orangish) tubeworms and sulfide.	Vining	9/9 12:02	* 45° 55.9981'N	130° 0.82362'W	1544	335.9	5218
J729-GTB-04	gas	Hell	Beehive spigot with intense flow near top (3.4 m up) of sulfide covered in dense biota.	Gastight bottle nude-11 placed in flow of broken-off beehive. Jason temp was 296.5 C.	Evans	9/9 12:32	* 45° 55.9979'N	130° 0.83718'W	1540	252.08	5302
J729-microbio-05	bio	Hell	In little mound with hot fluid beehive spigots just below last sample site.	Small green syringe sample of sediment/biology combination. Great sample full of grey matter.	Vining	9/9 12:34	* 45° 55.9979'N	130° 0.83718'W	1540	252.74	5340
J729-GTB-06	gas	Inferno	Excavated hole from largest beehive in this area (not quite at the top) 2.7 meters up the chimney.	Gastight red-green-7 in the excavated hole (that was formerly a large beehive). Jason temp was 310.9C.	Evans	9/9 13:02	45° 56.0125'N	130° 0.8239'W	1540	261.26	5458
J729-GTB-07	gas			Gastight green-2 in the excavated hole (that was formerly a large beehive). Same position as last sample. Jason temp was 310.9C.	Evans	9/9 13:07	45° 56.0125'N	130° 0.8239'W	1540	261.49	5472
J729-microbio-08	bio	Inferno	Just to the left of the beehives that were sampled earlier.	Small red syringe sample in the sediment underneath the white mat. Just next to the beehives that were sampled earlier (samples 6 and 7).	Vining	9/9 13:11	45° 56.0125'N	130° 0.8239'W	1540	250.51	5500

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#

J2-730 Samples

J730-HFS-01	fluid	Bag City	White patch with biota on the edge of the collapse vertical face with fluid coming up. Sitting on the newer lava. Sampling in the old lava.	HFS unfiltered bag #17. Tmax=19.7 Tavg=19.5 T2=11.6 Vol=550 mL.	Butterfield	09/12 23:40	45° 54.9694'N	129° 59.3618'W	1532	312.86	10486
J730-HFS-02	fluid			Filtered bag #18. Start 2341. Tmax=19.9 Tavg=19.6 Vol=550mL.	Butterfield	09/12 23:41	45° 54.9694'N	129° 59.3618'W	1532	312.84	10491
J730-HFS-03	fluid			RNA filter #14. Tmax=20.8 Tavg=20.1 Vol=3012mL. T2=12.2.	Butterfield	09/12 23:45	45° 54.9694'N	129° 59.3618'W	1532	312.54	10495
J730-Rock-04	geo	~80m S of AX-105 South Pillow Mound	Old pillow lava flow (big pillows) with lots of sediment.	Tiny piece of lava rock from old solid pillow flow.	Butterfield	09/13 06:23	45° 53.189'N	129° 59.783'W	1719	55.54	11048
J730-HFS-05	fluid	Marker N3 vent site. Mkr-135 area.	In diffuse flow coming out of a crack between pillows. White floc and thick white mat at sampling site. Pre/post sample readings: Tmax=20C/19.9; O2= 0.133/0.121 mL/L; pH voltage= 2.766/4.379.	Unfiltered bag #19. HFS Tmax= 19.6C Tavg 19.1C T2= 11C Vol=550 mL.	Butterfield	09/13 22:04	45° 56.6218'N	129° 59.1107'W	1522	269.02	12282
J730-HFS-06	fluid			Filtered bag #20. Tmax= 18.9 Tavg= 17.5C T2= 10C Vol= 558mL.	Butterfield	09/13 22:09	45° 56.6218'N	129° 59.1107'W	1522	269.2	12295
J730-GTHFS-07	gas			HFS gastight. Purple-10. T=19.2C	Butterfield	09/13 22:13	45° 56.6218'N	129° 59.1107'W	1522	269.3	12303
J730-HFS-08	fluid			Unfiltered bag #21. Tmax= 19.8C Tavg= 19.7C T2= 11C Vol= 552mL.	Butterfield	09/13 22:21	45° 56.6218'N	129° 59.1107'W	1522	269.03	12314
J730-HFS-09	fluid			Large volume bag (LVB) position #1. Tmax= 20.1C Tavg= 19.6C T2= 11C Vol= 4002mL.	Butterfield	09/13 22:23	45° 56.6218'N	129° 59.1107'W	1522	268.28	12321
J730-HFS-10	fluid			Unfiltered piston #7. Tmax= 20.1C Tavg= 19.5C T2= 11C Vol= 653mL.	Butterfield	09/13 22:41	45° 56.6218'N	129° 59.1107'W	1522	268.25	12371
J730-HFS-11	fluid			RNA filter #10. Vol=3003mL. Tmax=20.1 Tavg=19.7 T2=10.7.	Butterfield	09/13 22:46	45° 56.6218'N	129° 59.1107'W	1522	268.1	12379
J730-HFS-12	fluid			RNA filter #11. Vol=3001 mL. Tmax=20.1 Tavg-19.6 T2=10.8.	Butterfield	09/13 23:02	45° 56.6218'N	129° 59.1107'W	1522	269.46	12410
J730-HFS-13	fluid	Trevi	Jason Tmax=257.9 C. In the direct flow at this small anhydrite mound (anhydrite knocked over).	Filtered piston #2. Tmax=250.4 Tavg=250.0 T2=85. Vol=352mL.	Butterfield	09/14 01:21	45° 56.7759'N	129° 59.0235'W	1520	271.1	12703
J730-HFS-14	fluid			Unfiltered piston #3. Tmax=-250.2 Tavg=250 T2=85 Vol=352 mL.	Butterfield	09/14 01:24	45° 56.7759'N	129° 59.0235'W	1520	271.1	12705
J730-HFS-15	fluid			Filtered piston #4. Tmax=250.2 Tavg=249.9 T2=86. Vol=352mL.	Butterfield	09/14 01:27	45° 56.7759'N	129° 59.0235'W	1520	271.1	12709
J730-GTHFS-16	gas			HFS gastight. Red-center-9. T=250C	Evans	09/14 01:30	45° 56.7759'N	129° 59.0235'W	1520	271.12	12712

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J730-GTHFS-17	gas			HFS gastight. White-stbd-17. T=249C	Evans	09/14 01:31	45° 56.7759'N	129° 59.0235'W	1520	271.12	12716
J730-HFS-18	fluid	Spanish Steps	Little mound of dense biota and good flow - in tubeworm bush. Oxygen = 0.393 mL/L. pH voltage = 3.016.	Filtered piston #9. Tmax=20.0 Tavg=17.8 Vol=700 mL T2=10.	Butterfield	09/14 01:54	45° 56.7651'N	129° 59.0191'W	1519	56.98	12798
J730-HFS-19	fluid			Unfiltered piston #9. Tmax=24.5 Tavg=2.6 T2=12. Vol=720 mL.	Butterfield	09/14 01:58	45° 56.7651'N	129° 59.0191'W	1519	56.96	12808
J730-HFS-20	fluid			RNA filter #15. Tmax=24.6 Tavg=21.3 T2=12. Vol=3000 mL.	Butterfield	09/14 02:07	45° 56.7651'N	129° 59.0191'W	1519	57.62	12822
J730-HFS-21	fluid	North of Trevi	Above sediment-covered older lineated sheet flows. On the edge of the caldera wall. 2-5 meters above the bottom.	Background water sample. Unfiltered bag #23. T2=2.3 Tmax=2.5 Tavg=2.4.	Butterfield	09/14 02:37	45° 56.82'N	129° 59.031'W	1518	344.75	12895
J730-microbio-22	bio	North of Trevi	Eastern edge of a collapse area.	Large green syringe sample of small patch of red mat. Nice sample.	Vining	09/14 04:02	45° 56.8927'N	129° 59.0902'W	1522	167.89	13100
J730-microbio-23	bio			Small red/blue RNA syringe sample of small patch of red mat.	Vining	09/14 04:15	45° 56.8927'N	129° 59.0902'W	1522	215.16	13143
J730-microbio-24	bio	North of Trevi	Eastern edge of a collapse area.	Large white syringe sample of red mat in area south of the last sampling position. Mat is on top of the basalt (compared to orange hydrothermal seds at the bases and cracks).	Vining	09/14 04:30	45° 56.891'N	129° 59.0912'W	1522	137.65	13188

J2-731 Samples

J731-HFS-01	fluid	Dependable West	Worm-covered Diffuser. Dependable West sulfide structure. In diffuse flow near the bottom of a tubeworm patch with white mat and dense biota. Jason T=26C. Oxygen=0.867 mL/L. pH voltage=3.28.	Filtered bag #18. Temperature recording not functioning well. Temp = 22 to 26C. Vol=630mL.	Butterfield	09/15 01:57	45° 52.7707'N	129° 48.2615'N	1941	39.7	14450
J731-HFS-02	fluid			RNA filter #10. Tmax= 25.3 Tavg=24.1 Vol=2991 mL. T2=12. Sample stopped because computer shut down for a minute.	Butterfield	09/15 02:00	45° 52.7707'N	129° 48.2615'N	1941	39.94	14455
J731-HFS-03	fluid			Unfiltered bag #19. Tmax=23.7 Tavg=22.8 Vol=629 mL. T2=12.0.	Butterfield	09/15 02:23	45° 52.7707'N	129° 48.2615'N	1941	39.91	14519
J731-sulfide-04	geo	Dependable	Main Dependable structure - SE Base (west of the saddle).	Thought to be a large chunk of basalt talus but turned out to be sulfide.	Kelley	09/15 03:31	45° 52.7951'N	129° 48.1527'N	1948	304.87	14663

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J731-HFS-05	fluid	Dependable	Rusty Site: Old venting sulfide chimney. Sample position 9 m up; Hdg 256deg. East side of main Dependable structure. Oxygen=0.16	Piston #9 unfiltered. Tmax=56.9 Tavg=47.1 Vol=700 T2=20 J731-HFS-05.	Butterfield	09/15 04:07	45° 52.8013'N	129° 48.1686'N	1922	253.36	14837
J731-GTHFS-06	gas			HFS gastight port blue #12. T=41.	Evans	09/15 04:18	45° 52.8013'N	129° 48.1686'N	1922	253.53	14842
J731-HFS-07	fluid			Filtered piston #8. Tmax=38.6 Tavg=35.2 Vol=628 T2=15. Not convinced that this ran the whole time.	Butterfield	09/15 04:20	45° 52.8013'N	129° 48.1686'N	1922	254.27	14853
J731-HFS-08	fluid	Dependable	Small Spire: Area of good flow on spire. North side of main Dependable structure. Looking south. Above and to the right of Mkr-142. Hdg 181 deg.	Filtered piston #2. Tmax=150.4 Tavg=143.1 Vol=600 T2=60..	Butterfield	09/15 05:35	45° 52.807'N	129° 48.171'N	1919	181.28	15130
J731-HFS-09	fluid			Unfiltered piston #3. Tmax=141.8 Tavg=140.2 Vol=629 mL T2=58.0.	Butterfield	09/15 05:38	45° 52.807'N	129° 48.171'N	1919	181.27	15131
J731-GTHFS-10	gas			HFS gastight center orange-16. T=145.	Evans	09/15 05:43	45° 52.807'N	129° 48.171'N	1919	181.35	15142
J731-HFS-11	fluid			Filtered bag #24. Tmax=163.9 Tavg=161.7 T2=49 Vol=626 mL.	Butterfield	09/15 05:45	45° 52.807'N	129° 48.171'N	1919	181.4	15154
J731-GTB-12	gas	Dependable	Trusty Chimney site: Very small chimney on the north side of main Dependable structure. Jason temp=216.2 deg.	Hand-held gastight bottle - green #2.	Evans	09/15 06:18	45° 52.7952'N	129° 48.1766'N	1917	177.89	15257
J731-HFS-13	fluid			Filtered piston #4. HFS Tmax=183.8 Tavg=175.7 vol=601 T2=56. J731-HFS-13 at Trusty.	Butterfield	09/15 06:26	45° 52.7952'N	129° 48.1766'N	1917	177.72	15278
J731-Sulfide-14	geo	Dependable	Gargoyle site: Area of flanges and visible diffuse venting. Main Dependable structure. Jason temp in flow under the flange is 174C.	Pieces of flange and sulfide for Deb Kelly (UW).	Kelley	09/15 06:57	45° 52.7953'N	129° 48.1818'N	1915	154.19	15381
J731-HFS-15	fluid	Dependable Mound	Area with a little bit of diffuse flow near a broken off chimney. HFS Tmax= 46.8C O2=0.171 ml/L; pH voltage= 4.513.	Filtered bag #20. Tmax= 48.6C Tavg= 47.6C T2= 20C Vol= 654mL.	Butterfield	09/15 09:02	45° 52.7979'N	129° 48.1838'N	1914	68.09	15730
J731-HFS-16	fluid			Unfiltered bag #21. Tmax= 49.2C Tavg= 48.0C T2= 20C Vol= 653mL.	Butterfield	09/15 09:06	45° 52.7979'N	129° 48.1838'N	1914	67.99	15737
J731-HFS-17	fluid			Large volume bag (LVB) #1. Tmax= 50.0C Tavg= 48.8C T2= 22C Vol= 4002mL.	Butterfield	09/15 09:09	45° 52.7979'N	129° 48.1838'N	1914	67.89	15742
J731-HFS-18	fluid			RNA filter #15. Tmax= 53.3C Tavg= 51.2C T2= 21C Vol= 3001mL.	Butterfield	09/15 09:28	45° 52.7979'N	129° 48.1838'N	1914	67.72	15764
J731-HFS-19	fluid			RNA filter #16. Tmax= 53.2C Tavg= 51.5C T2= 21C Vol= 3003mL.	Butterfield	09/15 09:47	45° 52.7979'N	129° 48.1838'N	1914	67.61	15786

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J731-microbio-20	bio	Dependable Mound	A few feet away from prevous sampling area near a broken off chimney. Tmax=2.2C; O2= 1.223 mL/L.	Large white syringe sample of grey sediment with a small patch of white mat on the surface.	Vining	09/15 10:08	45° 52.7979'N	129° 48.1838'N	1913	67.78	15845
J731-microbio-21	bio	Northeast of Undependable	On sedimented seafloor traveling from Undependable to the northeast of the Dependable's SE cone.	Small blue syringe sample of sediment on the seafloor.	Vining	09/15 12:28	45° 52.727'N	129° 48.099'N	1979	77.08	16098
J731-Rock-22	geo	North Dependable	South face of North Dependable: Heavily sedimented huge constructional pillow mound to the north of Dependable dubbed North Dependable.	Collected a couple pieces of oxidized pillow lava for Tito.	Collasius	09/15 13:40	45° 52.8853'N	129° 48.1648'N	1958	34.23	16256
J731-Sulfide-23	geo	North Dependable	South face of North Dependable: Heavily sedimented huge constructional pillow mound to the north of Dependable dubbed North Dependable. Upslope from previous sample.	Piece of pillow lava for Dave Clague	Clague	09/15 13:52	45° 52.9215'N	129° 48.1877'N	1948	322.95	16288

J2-732 Samples

J732-microbio-01	bio	Red Bridges	Skinny pillar in the middle of the collapse with red mat on top.	Large green syringe sample of red mat.	Vining	09/16 05:55	45° 56.8854'N	129° 59.0848'W	1522	249.9	17630
J732-microbio-02	bio			Large white syringe sample of orange sediment adjacent to the red mat.	Vining	09/16 06:01	45° 56.8854'N	129° 59.0848'W	1522	251.13	17649
J732-Rock-03	geo			Freshly exposed basalt from pillar where sediment samples were taken. Piece from top with red mat on it. Very large.	Vining	09/16 06:14	45° 56.8854'N	129° 59.0848'W	1522	251.13	17649

Sample	Type	Site	Site Description	Sample Descriptions	Contact	Date Time	* Corrected position - differs from lat/long in dive log Latitude	Longitude	Depth	heading	Virtual Van#
J732-Rock-04	geo	n/a	Collapse area of glassy and jumbled sheet flows in northern 2011 lavas.	Piece of brittle fragile 2011 lava.	Teasdale	09/16 08:30	45° 56.8764'N	129° 59.9164'W	1530	258.5	18110
J732-Rock-05	geo	n/a	Contact 2011 and older lava flow. Area of intact pillows; lobate flow near collapse edge.	Piece of 2011 lava in area of new lobate flow extending out into old sedimented lineated flow.	Teasdale	09/16 09:25	45° 57.0988'N	130° 0.2452'W	1531	319.28	18470