Axial 2015 Cruise Report

Axial Seamount, Juan de Fuca Ridge

R/V Thompson TN327

August 14-29, 2015
JASON Dives J2-820 – J2-826

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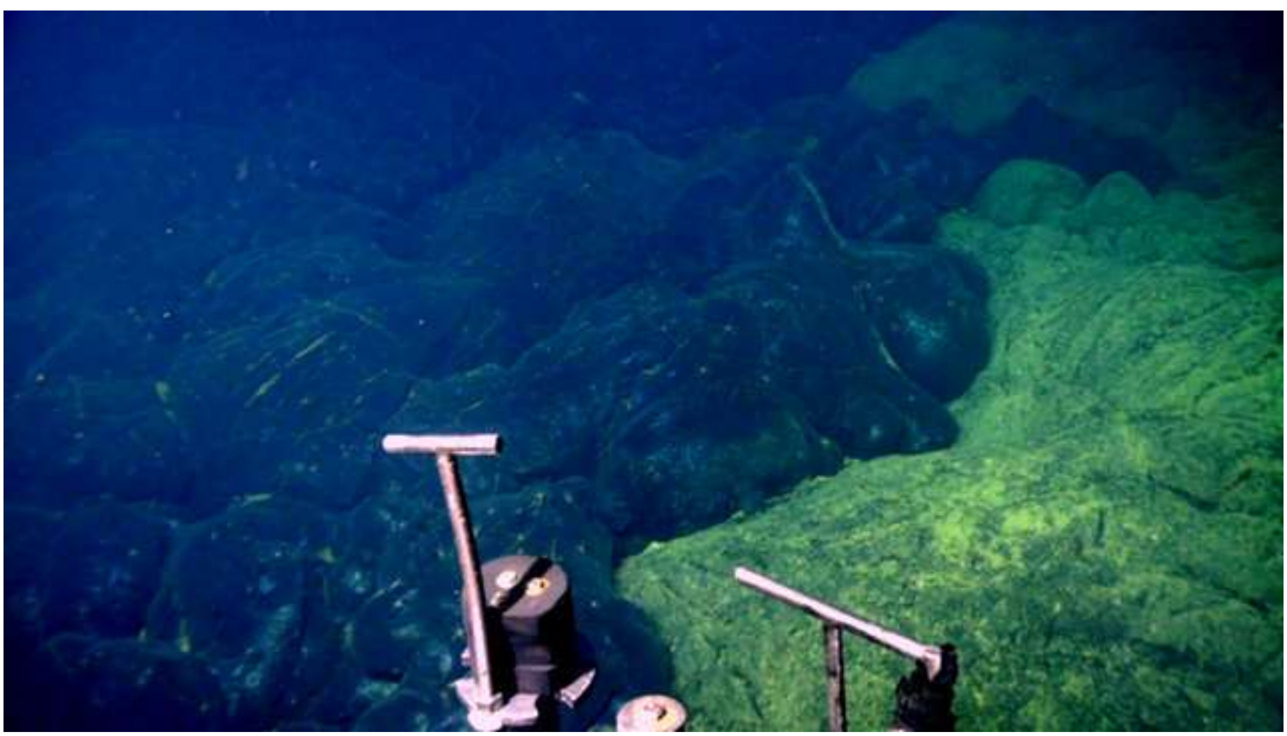

New 2015 lavas on older flow inside Axial's caldera from Jason dive J2-822.

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Axial 2015 Expedition Cruise Report

1 - Expedition Summary

Bill Chadwick, Chief Scientist

Our 2015 expedition to Axial Seamount was very successful. The big excitement this year was our "event response" work related to the April-May 2015 eruption at Axial, in addition to continuing important geophysical, chemical, and biological time-series at this very active submarine volcano. Despite losing 3 full days to bad weather, we managed to complete all our major goals with the skilled support of the R/V Thompson's crew, the ROV Jason and AUV Sentry teams, and our hard-working group of scientists. This research cruise had three interrelated components.

The first component was to make seafloor pressure measurements with ROV Jason at an array of seafloor benchmarks in and around the Axial caldera to continue our long-term time-series of volcanic inflation/deflation. This was accomplished during two long Jason dives, J2-823 and J2-824. We also recovered 3 autonomous bottom pressure recorder (BPR) moorings that had been deployed since the summer of 2013, and so had recorded data during the 2015 eruption. We re-deployed 2 of the 3 BPRs and the third was brought back to Seattle for servicing. The April 2015 eruption was successfully forecast 7-months in advance, based on this long-term inflation/deflation record. This year, AUV Sentry was added on the cruise in order to conduct repeat bathymetric mapping to detect the vertical deformation of the seafloor at Axial, to compliment the seafloor pressure measurements. AUV Sentry repeated some of the tracklines run by MBARI in 2014 (dive 339) and expanded the coverage beyond the caldera to compare with future resurveys (dive 340). This project was led by Scott Nooner and Bill Chadwick, and was funded by the National Science Foundation (NSF).

The second component was to collect fluid and microbial samples from Axial's hydrothermal vents to better understand the chemistry of hydrothermal systems, their microbial communities, and how they change with time. This work continues a long-term time-series and a highlight this year was the successful use of an incubator on the PMEL hot fluid and particle sampler to determine if in-situ experiments on the seafloor produce different results than those in the laboratory. Another important goal was to see how the 2015 eruption had affected Axial's hydrothermal systems. This work was accomplished during Jason dives J2-822 and J2-825, and parts of other dives. This project was led by Dave Butterfield, Jim Holden and Julie Huber and was funded by NOAA/PMEL and the Gordon and Betty Moore Foundation.

The third component was to explore and sample the new lava flows from the 2015 eruption, work that was funded by NSF and NOAA through a RAPID proposal that added 3 days to the cruise. Four of the ROV Jason dives (J2-820, J2-822, J2-825, and J2-826) collected rock, fluid, and biological samples and made visual observations over the 2015 lava flows. AUV Sentry collected high-resolution multibeam bathymetry over the 2015 lava flows during dives 338 and 341 (and water column data during dive 336). We also deployed a RAS mooring with a time-series chemical sampler and a MAPR mooring with temperature and turbidity sensors at different heights above the seafloor on Axial's North Rift Zone. As part of this work, we also conducted 4 CTD tows and 4 CTD casts to determine the distribution of hydrothermal plumes in the water column in the aftermath of the 2015 eruption. In addition, we recovered 1 self-calibrating pressure recorder (SCPR) and recovered and re-deployed 1 ocean-bottom hydrophone (OBH). Lastly, we collected multibeam sonar data with the Thompson's EM302 system over Axial's south rift zone, and found no evidence of eruptive activity there in 2015.

Outreach activities during the cruise were led by our teacher-at-sea, Rachel Teasdale and our videographer Jesse Crowell. While at sea, we made daily posts to our cruise blog: axial2015.blogspot.com, which was mirrored on the OceanScape Network website, in partnership with the Oregon Coast Aquarium. In addition, we made almost-daily Skype calls to shore with west coast science classrooms, a STEM summer camp, and a public audience at the Hatfield Marine Science Center.

As always, 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 ROV Jason and AUV Sentry teams.

2 - Cruise Participants

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Jim Pelowski	Jason group	ROV	
Ben Tradd	Jason group	ROV	
Jim Varnum	Jason group	ROV	
Korey Verhein	Jason group	ROV	
Brandi Murphy	U. Washington	Marine Technician	
Jen Nomura	U. Washington	Marine Technician	

3 - Operations Log

Pacific Time (-7 GMT)	Date/Time GMT	Operation
8/14/2015 09:00	8/14/2015 16:00	Departed Pier 91, Seattle.
8/15/2015 15:38	8/15/2015 22:38	**CTD cast V15A-01**: 45° 16.654'N 129°47.701'W depth=2129
8/15/2015 18:24	8/16/2015 01:24	Elevator deployed: 46° 16.3848'N 129° 47.8110'W depth=2130
8/15/2015 19:50	8/16/2015 02:50	SS Morningstar sailboat deployed. (Tillamook High School project)
8/16/2015 08:25	8/16/2015 15:25	Attempted to release elevator from seafloor (unsuccessful)
8/16/2015 12:22	8/16/2015 19:22	AUV **Sentry Dive 336** launched to explore NRZ lava flow. 46° 4.5288'N 129° 58.2564'W
8/16/2015 15:30	8/16/2015 22:30	Medea launched for 4-hour test dive.
8/16/2015 18:50	8/17/2015 01:50	Medea on deck.
8/17/2015 00:10	8/17/2015 07:10	Begin **Jason Dive J2-820** at NRZ lava mounds.
8/17/2015 08:41	8/17/2015 15:41	End dive J2-820.
8/17/2015 15:05	8/17/2015 22:05	End Sentry dive 336.
8/17/2015 16:45	8/17/2015 23:45	Verified elevator still on bottom.
8/17/2015 17:46	8/18/2015 00:46	**Jason Dive J2-821** (Engineering dive; no navigation).
8/17/2015 18:50	8/18/2015 01:50	Jason successfully released elevator.
8/17/2015 20:20	8/18/2015 03:20	End dive J2-821.
8/17/2015 20:53	8/18/2015 03:53	Elevator on deck.
8/17/2015 22:34	8/18/2015 05:34	**CTD tow T15A-01** Over NRZ thick lava flows. Begin: 46° 8.0784'N 129° 57.4212'W
8/17/2015 22:34	8/18/2015 05:34	CTD tow T15A-01 End: 46° 3.3804'N 130° 0.2892'W
8/18/2015 07:46	8/18/2015 14:46	OBH release code sent and confirmed.
8/18/2015 08:37	8/18/2015 15:37	OBH on deck.
8/18/2015 08:57	8/18/2015 15:57	BPR-South 2 release code sent and confirmed
8/18/2015 09:35	8/18/2015 16:35	BPR-South 2 on deck.
8/18/2015 09:48	8/18/2015 16:48	BPR-South 1 release code sent and confirmed.
8/18/2015 10:36	8/18/2015 17:36	BPR-South 1 on deck.
8/18/2015 11:22	8/18/2015 18:22	SCPR release code sent and no response.
8/18/2015 13:30	8/18/2015 20:30	Stopped pinging on SCPR (no response).
8/18/2015 15:32	8/18/2015 22:32	Start EM302 survey from north to south caldera. Began SOL-68.
8/18/2015 15:43	8/18/2015 22:43	Stopped EM302 survey due to bad data (weather).
8/18/2015 17:45	8/19/2015 00:45	**CTD cast V15A-02** at Vixen. 45° 66.048'N 129° 59.573'W.
8/18/2015 22:12	8/19/2015 05:12	**CTD cast V15A-03** at ASHES. 45° 56.014'N 130° 0.820'W
8/19/2015 14:55	8/19/2015 21:55	**Deployed BPR-South 2**. 45° 54.956'N 129° 59.636'W depth=1538.
8/19/2015 18:05	8/20/2015 01:05	**Deployed OBH** on NRZ. 46° 05.7652N 129° 58.8176W
8/19/2015 20:45	8/20/2015 03:45	CTD tow **T15A-02**. NRZ 2015 flow at NE caldera. Begin: 46° 0.8100'N 130° 1.3302'W
8/20/2015 02:30	8/20/2015 09:30	CTD tow T15A-02 End: 46° 56.5056'N 129° 59.2272'W
8/20/2015 04:20	8/20/2015 11:20	AUV **Sentry Dive 337** begin.
8/20/2015 11:10	8/20/2015 18:10	Sentry recovered.

Pacific Time (-7 GMT)	Date/Time GMT	Operation
8/20/2015 13:00	8/20/2015 20:00	CTD cast **V15A-04** at International District. 45° 55.5768'N 129° 58.7982'W
8/20/2015 16:15	8/20/2015 23:15	Begin **Jason Dive J2-822**.
8/21/2015 08:50	8/21/2015 15:50	AUV **Sentry Dive 338** begin.
8/21/2015 16:04	8/21/2015 23:04	End Jason dive J2-822.
8/21/2015 20:44	8/22/2015 03:44	Sentry recovered.
8/21/2015 00:06	8/21/2015 07:06	Begin EM302 survey. SOL 071.
8/22/2015 05:09	8/22/2015 12:09	End EM302 survey. EOL 081.
8/22/2015 08:09	8/22/2015 15:09	Begin **Jason Dive J2-823** (Pressure Dive).
8/22/2015 17:05	8/23/2015 00:05	AUV **Sentry Dive 339** begin.
8/23/2015 10:49	8/23/2015 17:49	SCPR mooring released by Jason from seafloor on J2-823.
8/23/2015 12:00	8/23/2015 19:00	SCPR on deck.
8/23/2015 17:18	8/24/2015 00:18	AUV Sentry on deck.
8/24/2015 04:05	8/24/2015 11:05	End Jason dive J2-823. (Two MISO instruments, with no data, lost on recovery).
8/24/2015 05:41	8/24/2015 12:41	CTD tow **T15A-03**. NRZ fissure. Start: 46° 1.2564'N 130° 0.4758'W
8/24/2015 08:50	8/24/2015 15:50	CTD tow T15A-03. End: 45° 58.4064'N 130° 1.0398'W
8/24/2015 12:08	8/24/2015 19:08	Begin **Jason Dive J2-824** (2nd Pressure dive).
8/24/2015 14:06	8/24/2015 21:06	AUV **Sentry Dive 340** begin.
8/25/2015 13:31	8/25/2015 20:31	Sentry recovered.
8/25/2015 17:31	8/26/2015 00:31	End Jason dive J2-824.
8/25/2015 22:05	8/26/2015 05:05	CTD tow **T15A-04** Begin: 46° 0.7704'N 130° 1.2504'W
8/26/2015 02:40	8/26/2015 09:40	CTD T15A-04 End: 46° 4.4052'N 129° 59.6556'W
8/26/2015 08:06	8/26/2015 15:06	Begin **Jason Dive J2-825**.
8/26/2015 15:48	8/26/2015 22:48	AUV **Sentry Dive 341** begin.
8/26/2015 16:58	8/26/2015 23:58	BPR-Center release code sent and acknowledged.
8/26/2015 17:46	8/27/2015 00:46	BPR-Center on deck.
8/27/2015 04:00	8/27/2015 11:00	End Jason dive J2-825.
8/27/2015 05:40	8/27/2015 12:40	**BPR-Center** deployed. 45° 57.407N 130° 00.636W
8/27/2015 07:53	8/27/2015 14:53	AUV Sentry on deck.
8/27/2015 09:55	8/27/2015 16:55	**MAPR mooring** deployed. 46° 5.6226'N 129° 58.867'W
8/27/2015 11:50	8/27/2015 18:50	**RAS mooring** deployed. 46° 4.4934'N 129° 59.7102'W
8/27/2015 12:37	8/27/2015 19:37	Begin **Jason Dive J2-826**.
8/28/2015 00:06	8/28/2015 07:06	End Jason Dive J2-826.
8/29/2015 10:00	8/29/2015 17:00	Cruise ends. R/V Thompson arrives at UW Marine Facility pier.

4 - Discipline Summaries

4.1 Geology/Geophysics

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

Scott Nooner, Bill Chadwick, and Glenn Sasagawa

We have made ROV-based pressure measurements with a "mobile pressure recorder" (MPR) 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. In addition, we have deployed autonomous bottom pressure recorder (BPR) moorings that record continuously for 1-3 years at a time. If the MPR measurements are co-located with a BPR, then the MPR data can determine the instrumental drift of a BPR. What is new this year is that for the first time we have deformation results from our expanded array of 9 MPR benchmarks in the caldera, and from 3 BPRs that were located near MPR benchmarks (so their drift can be determined). We were also able to determine the drift of the OOI-BPR at the center of the caldera for the first time (MJ03F-BOTPT01), but we will not be able to constrain the drift on the other two OOI-BPRs (MJ03E and MJ03D) until the next MPR survey. This year's operations included the following:

1) We recovered the three BPRs that were deployed in 2013 and they all had successfully recorded, including during the 2015 eruption. Two of the three BPRs (Center and South2) were turned-around at sea and redeployed at the same positions (see table below). The third BPR (South1) failed on the ship and was returned to Seattle for maintenance.

BPR Deployment Locations (drop positions – not surveyed by Workboat)

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-South2	45	54.959	-129	59.609	45.91599	-129.99348	1540

2) There are now a total of 10 cement benchmarks for the MPR surveys.

Cement Benchmark Locations

AXIAL CEMENT BENCHMARK NAMES	LAT	LON	Depth	LAT DEG	LAT MIN	LON DEG	LON MIN
AX-101 Caldera Center	45.95520	-130.00987	1532	45	57.312	-130	0.592
AX-104 Bag City	45.91617	-129.98950	1534	45	54.970	-129	59.370
AX-105 Pillow Mound	45.86317	-130.00376	1718	45	51.790	-130	0.225
AX-106 Ashes	45.93445	-130.01160	1542	45	56.067	-130	0.696
AX-302 Trevi	45.94642	-129.98378	1522	45	56.785	-129	59.027
AX-303 Marker 33 site	45.93346	-129.98225	1516	45	56.008	-129	58.935
AX-307 Magnesia West	45.94535	-130.00906	1544	45	56.721	-130	0.544
AX-308 BPR-South1	45.93160	-129.99880	1533	45	55.896	-129	59.928
AX-309 RSN-PN	45.93835	-129.97208	1527	45	56.301	-129	58.325
AX-310 IntDist	45.92580	-129.97787	1531	45	55.548	-129	58.672

The MPR measurements provide a precise depth for each benchmark *relative* to the reference site AX-105 (Pillow Mound) that is located ~10 km south of the center of the caldera. This year, the pressure was measured at all the benchmarks during Jason dives J2-823 and J2-824. Dive J2-823 had to be aborted during the MPR survey due to a hydraulic leak on the ram that controls Jason's basket. The dive started at AX-105, did one question-mark-shaped northward traverse to AX-308, and most one one southward traverse; the dive was aborted after the 2^{nd} measurement at AX104. After an 8-hour turn-around to repair Jason, we resumed the MPR survey on dive J2-824. That dive started at AX-106, made repeated measurements at AX-308, and ended at AX-105. Thus, each dive made at least one repeat measurement and made at least one measurement at AX-105. As in previous years, each measurement was made by placing the MPR on top of a benchmark and recording for 20 minutes. Data were recorded in a laptop PC in the Jason control room. The two Paros pressure gauges that we have used in the past (s/n 43535 and 62201) were used again this year. We conducted some fluid sampling for Dave Butterfield during J2-824. The average transit speed for towing Jason from benchmark to benchmark was about 1 knot.

The MPR pressure data were converted to depth then corrected for ocean tides using data collected by our BPR-Center mooring. 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 ± 1.17 cm this year, so the survey did not appear to suffer too much from breaking it up over two dives. Comparing the benchmark depths in 2015 to our previous survey in 2013 shows the following depth changes (which include pre-eruption inflation, co-eruption deflation, and post-eruption re-inflation).

Depth changes from 2013 to 2015 at MPR benchmarks.

BENCHMARK NAME	**Depth change (cm)**
AX-101 Caldera Center	-93.9
AX-104 Bag City	-54.18
AX-105 Pillow Mound	0.0
AX-106 Ashes	-63.8
AX-302 Trevi	-54.31
AX-303 Marker 33 site	-65.32
AX-307 Magnesia West	-90.93
AX-308 BPR-South1	-79.11
AX-309 RSN-PN	-40.57
AX-310 IntDist	-60.56

3) In addition this year, during Jason dive J2-823, we deployed 6 mini-BPRs on all of the MPR benchmarks that do not have a BPR-mooring or an OOI-cabled-BPR nearby (see table below). The mini-BPRs have small pressure cases and are battery-powered, internally-recording, and must be deployed and recovered by an ROV. They allow us (for the first time) to have both continuous BPR data and campaign-style MPR measurements at every site, and the drift of all BPRs will be able to be removed with the results from the next MPR measurements. The mini-BPRs were built at Scripps by Glenn Sasagawa and Scott Nooner.

BENCHMARK NAME	**Mini-BPR**	**Paros S/N**	**Paros model**	**Range (psi)**
AX-105 Pillow Mound	Blue-Black #13	132674	46K	6000
AX-106 Ashes	Red-Black #9	127331	43K	3000
AX-302 Trevi	Yellow #6	125331	42K	2000
AX-303 Marker 33 site	Blue #12	132673	46K	6000
AX-307 Magnesia West	Yellow-Black #7	125573	42K	2000
AX-308 BPR-South1	Red #8	127329	43K	3000

Summary

The data from the 2015 MPR survey and the BPRs that were recovered show the following: (1) The pre-eruption inflation rate between the 2011 and 2015 eruptions was variable but generally increased with time. (2) The co-eruption deflation was a maximum of -2.45 m at the center of the caldera and the duration of deflation varied by site but was up to 25 days at BPR-South-1. (3) The post-eruption inflation rate has remained high since the April 2015 eruption, between 60-80 cm/yr. (4) The spatial distribution of deformation seems to be consistent with the magma chamber shape derived from the multi-channel seismic results – that is, cigar shaped with a long-axis similar to that of the caldera and offset to the east side the caldera. (5) All the 3 of our autonomous BPRs and all 3 of the OOI cabled BPRs and the SCPR BPR measured a bell-shaped temperature increase of about 0.7°C followed by a decrease, which lasted about a month. The area of the temperature increase was at least 5 km across. (6) The drift of the OOI-BPR at the caldera center (MJ03F-BOTPT01) can be estimated for the first time by comparing it to the drift-corrected Center-BPR autonomous mooring. Such a comparison suggests the OOI-BPR drift is near zero, but this will have to be confirmed by the next MPR survey, which is a more precise determination. (7) The success of the 2015 eruption forecast and the high inflation rate since the 2015 eruption suggests that the time-period until the next eruption will be short again (perhaps like between the 2011-2015 eruptions). A more specific forecast will have to wait for a more detailed analysis of the data. This work was funded by the National Science Foundation.

4.1.2 – Rock Collections

Jenny Paduan and Bill Chadwick

Twenty-five lava samples of the Axial 2015 flows were collected on *Jason* dives 820 and 826 on the North Rift Zone, dive 822 on the NE caldera floor, and dive 825 on the north caldera rim and Upper North Rift Zone (Table 4.1.2-1, Figures 4.1.2 1-3). The locations of these flows had been identified by comparing multibeam bathymetry data taken before the eruption (R/V *Thompson* TN302 and MBARI Mapping AUV) with data collected after the eruption (EM302 collected on TN326 in July, and AUV *Sentry* multibeam on this cruise). Contacts between younger-looking lavas and older lavas observed on ROV *Jason* dives refined interpretations of mapped flow boundaries (Figure 4.1.2-4).

Samples were collected to achieve a wide spatial distribution along the likely eruptive fissures and across some lava flows, and collected with the ROV manipulator (Figure 4.1.2-4). On board, samples were photographed and described (Table 4.1.2-1) and glass was chipped for electron microprobe analyses for major element composition by Dr. David Clague (MBARI) on shore. The rocks were shipped to Dr. Kenneth Rubin (University of Hawaii) for dating utilizing $^{210}Po/^{210}Pb$ radioactive disequilibrium, which should distinguish when, and for how long, the different fissures and parts of the flows were active.

In addition, particles of volcanic glass (ash) discovered on the AX-101 benchmark in the central caldera were collected as a suction sample (J823-Geo-01; Figure 4.1.2-5 and sieved on shore. The sample is entirely basaltic glass fragments, and is mostly limu o Pele (broken lava bubble walls), with less abundant angular grains and only very rare Pele’s hair. This benchmark was deployed in 2010, and no ash was observed on it during the last visit in 2013, so it is likely that these particles were produced by the 2015 eruption, advected with the hot eruption plume, and settled on the benchmark. The largest deposit of ash was found on benchmark AX-101 (by far), and smaller deposits were observed, but not sampled, on benchmarks AX-106, AX-302, AX-307 through AX-310, but were absent from AX-105 and AX-303. Benchmark AX-307 had the second largest deposit. On benchmark AX-104 there was too much bio-film and staining to tell whether there was ash there or not.

A sample of a much older flow was collected from near the Cabled Array primary node as payload ballast on dive J2-823 (J823-ballast). It will be analyzed by electron microprobe to augment existing collections of older flows by Dr. David Clague (MBARI), but as it is not a product of the 2015 eruption, and Po dating will not be performed.

Table 4.1.2-1 Geological Samples

Sample	Date Time	Latitude	Longitude	Depth (m)	Collection Comment	Description Comment	Virtual Van record #
J820-Geo-01	8/17/15 8:35	46.064717	-130.000233	1700.6	Glass rind broken from drained pillow, possibly from older flow; in box 10	Basaltic glass rind ~0.5cm thick. Dark gray interior; aphyric except for rare plag crystals to a few mm size; dark gray. Large vesicle/cavity 1.5cm long otherwise only suggestions of pipe vesicles ~1 cm in. Some of the original glass surface is retained on top surface (plenty of glass still left after manipulator broke off rest of fresh surface). Lower surface smooth no glass; cm-size cooling cracks delineated with orange bacterial mat; remnants of large lava drips. 11x8x3 cm.	48
J820-Geo-02	8/17/15 9:45	46.067200	-129.999285	1705.9	Glass rind from 2015 flow drained lobate; originally rectangular; broke up when dropped into box; in box 9	Glass rind 0.5 cm thick; most of original surface survived; smooth glossy. Interior dark gray; aphyric except for occasional crystals prob plagioclase to ~2mm. Another layer of glass is sandwiched through part of the interior; 0.4 cm thick at most. Only one vesicle/cavity 1.6 cm long. Bottom surface smooth; some drip ribs; not glassy. Orig size 17x14.5x2 cm	158
J820-Geo-03	8/17/15 11:13	46.071948	-129.997726	1722.3	Three separate grabs from same sheet flow of 2015 eruption; into box 7	Glass rind to 2 cm thick in folds; thin top and bottom elsewhere. Rare crystals prob plagioclase in glass and interior; to 2mm size some in clots. Occasional gas vesicles to 4mm; one has orange staining running from it; cracks orange too. Interior dark gray. Original glass surface retained on two larger pieces collected; most shaved off of smaller bud. 11x10x4cm; 8.5x6x4cm; 6.5x3x2.5cm.	324
J820-Geo-08	8/17/15 12:41	46.074910	-129.995107	1718.3	Large glassy basaltic pillow bud from 2015 eruption	Original glassy surface on all faces except where broken; thin to 5mm smooth; exfoliating. Orange bacterial mat/clay in cooling cracks and adhering to glass (latter subsampled by Emily into RNA-later). Piece looks like a ram's head in profile. Interior dark gray. Tiny vesicles throughout with hint of pipe vesicles; concentric ~1cm in; some filled with orange mat/clays. Two broken ends. Occasional crystals prob plagioclase in glass and interior. 20x19x14 cm.	530
J822-Geo-20	8/21/15 10:57	45.956012	-129.994011	1529	Pillow bud from 2015 eruption	Glass rind to 7mm thick, original surface retained in several places. Interior dark gray. Some alteration: lighter gray and orange. Interior hollow pipe, otherwise not vesicular. Sparsely plag phyric as individual crystals and clots. Crystals to 3mm clots to 7mm. Approx 17x15x12 cm if assembled (now in many pieces).	1509

Sample	Date Time	Latitude	Longitude	Depth (m)	Collection Comment	Description Comment	Virtual Van record #
J822-Geo-21	8/21/15 12:17	45.962944	-129.996231	1525	Collapsed shelf from 2015 eruption	Thick glass rind on top 1 cm thick, original smooth surface retained. Interior dark gray. Some orange staining in the cracks. Lava drips, almost glassy on under side of one piece, glass to 2mm thick on underside of other. Occasional vesicles folded in, one oval-shaped to 6mm wide, suggestion of pipe vesicles 1cm in on larger piece. Rare plag crystals 1mm size just below top glass layer; some plag clots appeared when dry to 4mm, also only at top. 2 pieces: 16x9x5.5 cm and 8x5.5x4.5 cm	1662
J822-Geo-22	8/21/15 13:28	45.968029	-130.000914	1540	Glassy crust broken from 2015 lobate flow	Collapsed lobate flow rind. Two layers of glass, one at top is 5mm thick. Antoher is beneath (sandwiched) that by 5mm of gray interior and is 4mm thick, but only on one of the freshly broken surfaces (it is not continuous though the sample). Interior is dark gray. Slightly more plag phyric than other previous samples; most are small (~2mm) except a few clusters (one is 5mm across). Top surface smooth original glass, some cracks. Bottom surface is shelf roof, some finer drips. Orange bacteria or clays in the few cracks. One edge is older altered brown with yellow deposits. Kept only largest piece: 15x12x4.5 cm.	1807
J822-Geo-23	8/21/15 14:55	45.973960	-130.002555	1542	Jumbled sheet flow from 2015 eruption in box 8. Large piece may be source of numerous "volunteers" on the front porch (Scott Nooner).	Original glass surface on all convoluted sides to 1.5 cm thick (and the folds are probably all glass). Interior dark gray. Plagioclase phenocrysts occasional (less sparse than earlier samples but not like south rift zone!) to 5mm. Orange bacteria or clay in cracks on smoother glass surfaces. Probable companion (volunteer) has a large gas cavity curving through the length of sample. In it are broken limu and a bubble inside that hasn't broken (limu within limu). Kept only larger pieces. Largest: 20x12x11 cm. Large volunteer: 19x17x16 cm.	1961
J822-Geo-24	8/21/15 17:48	45.978083	-130.012417	1570	In gas-tights box.	Lots of pieces but none seem to correspond with the framegrab. Note: I am not certain the hand sample piece is the correct sample, and it probably shouldn't be dated. Glassy exterior to 5mm thick; some original surface. Interior dark gray, some lighter gray alteration just underneath the glass. Gas pockets several cm long (longer before it broke up, e.g video and framegrab). Broken surfaces irregular (ie, not pillow wedge jointing). Large plag phencrysts more abundant than the other samples, to 5 mm. White deposits like veins. No bacterial mat remaining , but some orange stain in places where glass broke off.	2219

Sample	Date Time	Latitude	Longitude	Depth (m)	Collection Comment	Description Comment	Virtual Van record #
J822-Geo-25	8/21/15 19:06	45.982984	-130.011110	1579	Lobate pillow shattered into many pieces.	Most original glass peeled off; remaining is ~3mm thick. Interior dark gray, smooth textured with some light gray alteration in outer 1.5 cm. Internal texture is more rough (on broken surfaces). Gas pocket in center 3x1x0.5 cm. Plagioclase phenocrysts similar to R23 to 5mm. Orange bacteria/clays in a few cracks. Kept larger pieces. Reassembled: ~22x13x13 cm.	2327
J823-Geo-01	8/23/15 22:05	45.955300	-130.010000	1531	Glass particles suctioned off of AX-101 benchmark near the center of the caldera	Small glass particles (and limpets). Some limu visible to the naked eye. A smaller amoung also collected on the first pass through at 8/23 07:15	3053; 3496
J823-geo-02 ballast	8/24/15 3:49	45.938352	-129.972100	1526	Glassy layered rock from near RSN primary node	Several layers with glassy margins folded over large gas pockets, some of which are lined with glass, others not. Glass to 7mm thick. Aphyric. Manganese coated, some orange oxidation. 22x19x8 cm.	3620
J825-Geo-10	8/27/15 7:30	46.004373	-130.011241	1534	Pillow lava from 2015 flow; broken from rind of hollow pillow; in box 9	Some of the original glass surface remains; plenty of glass left, 1 cm thick. Pronounced white alteration stains surfaces exposed in cracks to fluids. Rare tiny plag crystals ~1mm. Non-vesicular. Was hollow inside; surface is sugary. 19x17x11 cm.	6117
J825-Geo-11	8/27/15 8:08	46.007604	-130.010630	1550	Collapsed lobate rind from 2015 flow; in box 7	Original glass surface mostly intact, 4 mm thick. 6 more glass layers on one face appear to be drainage shelves adhering (they don't run through the sample, as they would if it had been folded or many thin flows). Sparse plag phenocrysts to 2mm. Two gas vesicles to 1 cm long, oblong. Interior dark gray. Orange and pale gray staining toward bottom of sample. 9x7x5.5 cm.	6187
J825-Geo-12	8/27/15 8:25	46.008645	-130.009763	1556	Broken from roof of collapse in 2015 flow; into gas-tights box	Large lobate rind now in many pieces. Original glass surface survived; smooth with some breadcrusted cracks. Multiple glass layers adhering to one face, and one shelf on the largest piece, are remnants of drainage shelves. Interior dark gray. Gas pockets between shelf layers are large and abundant. Some orange staining on cracks. Bottom side has drips and is almost glassy. Largest pieces: 22x11x9 cm, 18x13x8 cm.	6209
J825-Geo-13	8/27/15 8:44	46.009377	-130.009283	1558	Glassy 2015 pillow near contact in box 10	Original glass layer mostly peeled off, plenty remains, a few mm thick. Interior dark gray, non-vesicular, smooth with some whitish alteration under the glass, more rough sugary interior. Curved lower face is hollow underside of pillow. Some thin lines of orange stain in interior. Sparse, larger plag phenos to 3mm size. 19x11x8 cm.	6244

Sample	Date Time	Latitude	Longitude	Depth (m)	Collection Comment	Description Comment	Virtual Van record #
J825-Geo-14	8/27/15 8:54	46.010664	-130.009092	1567	2015 basalt broken from jumbled sheet flow; into box 8	Complex piece. Glass to 1 cm thick on top (breadcrusted) and edges (smooth). Bottom side hollow gas cavity, smooth, with a piece peeling away like is delaminating. Interior dark gray. Plag phenos more abundant but still occasional, to 3mm. 10x7x4 cm.	6262
J825-Geo-15	8/27/15 9:10	46.011571	-130.010090	1574	2015 jumbled sheet flow near super-highway	Original glass surface partly intact, 5mm thick. Sagged roof glss and remnants of 3 drainage shelves veneer one side. Orange staining in cracks and on veneered side. Interior dark gray. Sparse plag phenos to 3 mm. Underside is disturbed and almost glassy, not a calm shelf. Two large pieces that fit together: 18x11x10 cm plus several smaller pieces.	6287
J825-Geo-16	8/27/15 9:26	46.012318	-130.012170	1578	2015 flow basalt pillow; in box 4	Curved pillow wedge. Glass surface scaly (original surface mostly peeled off), 7mm thick. Interior gray. Large plag phenocryst is 1 cm across; others much smaller and sparse. Some orange clays. Wavy gray deposits on underside. 17x11x10 cm	6309
J825-Geo-17	8/27/15 9:50	46.013463	-130.014934	1582	Elephant trunk from 2015 flow from contact with 2nd outcrop today of 2015 lava; on en echelon fissure system to previous samples	Enormous curved pillow tube. Most glass intact, 1 cm thick; has flowing textures rather than breadcrust. Orange stain abundant on original surface. Interior gray. Pipe vesicles 0.5 cm in from glass. Plag phenos to 3mm across. Hollow straw inside. 30x35x29 cm (the tube is 15 cm diameter). Chippeda bag of glass for Ken Rubin; Bill Chadwick is taking the rock to Newport as we couldn't break it up to fit in a bucket. Estimate weight at 70 lbs.	6346
J826-Geo-08	8/28/15 0:13	46.080111	-129.992412	1727	Upper crust from drained out area with bacterial mat; box 6; 2 pieces	Larger piece: original glass all peeled off, thin snake-skin textured glass remaining. Four glassy layers veneered to one face (residual shelves). Interior dar gray. Plagioclase phenocrysts sparse to 2mm, Orange clays in thin cracks, tan deposit on older faces. Rock is supposed to be from 2015 flow but looks old. Smaller piece has no glass; plag to 4 mm. 12x14x7 cm and 11x8x4.5 cm.	6689
J826-Geo-13	8/28/15 1:48	46.084414	-129.988937	1722	Folded sheet flow from 2015 eruption 400m S of wpt #6; box 7. (Described by video logger as a pillow)	Sheet flow buckled when glass had hardened. Original glass surface conplete, finely breadcrusted, 0.7 cm thick. Beneath glass is whate alteration or deposit. Interior medium gray and convoluted with numerous gas cavities. Small vesicles like ill-defined pipe vesicles ~2 cm in. No phenocrysts visible in the rock but the glass is riddled with plagioclase. 11x8x7.5 cm.	6877

Sample	Date Time	Latitude	Longitude	Depth (m)	Collection Comment	Description Comment	Virtual Van record #
J826-Geo-14	8/28/15 2:39	46.087888	-129.987334	1724	Pillow rind from 2015 flow; in box 9.	Wedge of hollow pillow. Original glass mostly intact and breadcrusted, to 1 cm thick. Interior medium gray. Many sub-mm crystals, a few plag to 1.5 mm. Narrow layer of small pipe vesicles 1 cm in; many small sub-mm vesicles throughout. Tan and light gray alteration/deposits on some joint faces. Bottom surface is rough, textured like drips but sugary, not smooth. 19x11x11 cm.	6961
J826-Geo-15	8/28/15 3:16	46.090661	-129.986150	1738	Pillow with some orange mat in box 8.	Large pillow bud. Some original glass is still present, remaining glass is snake-skin like. Interior dark gray. Tiny pipe vesicles 5mm below glass. Center of bud is also finely vesicular. May have some plag phenos ~1mm, rare. Radial jointing pattern to 3 cm in. 15x12x12 cm.	7034
J826-Geo-16	8/28/15 3:52	46.093756	-129.988791	1749	Large pillow bud from 2015 flow, with bacterial mat. Starboard biobox (after glass shed into boxes 8,9,10)	Lots of original glass peeled off when they tried to squeeze this sample into partitioned mild crate, much of it recovered (tho can't guarantee glass from rock box samples didn't get incorporated; chips for uprobe were taken from the rock itself, as with all the others). Original glass was at least 1 cm thick. What remains is thin snake-skin texture. Pipe vesicles 1 cm below glass, fine. Interior medium gray, finely vesicular. Sparse plag phenocrysts to 3 mm. Radial jointing pattern to 4 cm in. 18x16x14 cm.	7127
J826-Geo-19	8/28/15 4:57	46.094674	-129.988567	1745	Taken next to vent in 2015 flow; sampled at same site as HFS-17 and Major-18; into box 2 on swing arm.	Sheet flow piece. Original glass surface breadcrustey and broken, to 7 mm thick. Interior medium gray, with a glass shelf remnant 1 cm below outer glass, and a little bit of a second 1 cm below that. Tan and light gray alteration on joints. Sparse plag phenocrysts to 5 mm wide separately and in clots. 12.5x11x6 cm.	7279
J826-Geo-20	8/28/15 5:43	46.098564	-129.986663	1771	Large elongate pillow from 2015 flow, broke in 2; in dive weights box. Nav bad after HFS-17	Original glass surface mostly intact, smooth, to 7 mm thick, some fllowing textures. Interir dark gray. Suggestions of tiny pipe vesicles, otherwise non-vesicular. No hollow tube in center. Radial jointing extends to center. Mostly aphyric (might have plag phenos to 2mm). 28x17x16 cm and 20x17x12 cm (gave smaller piece to Rachel Teasdale).	7367

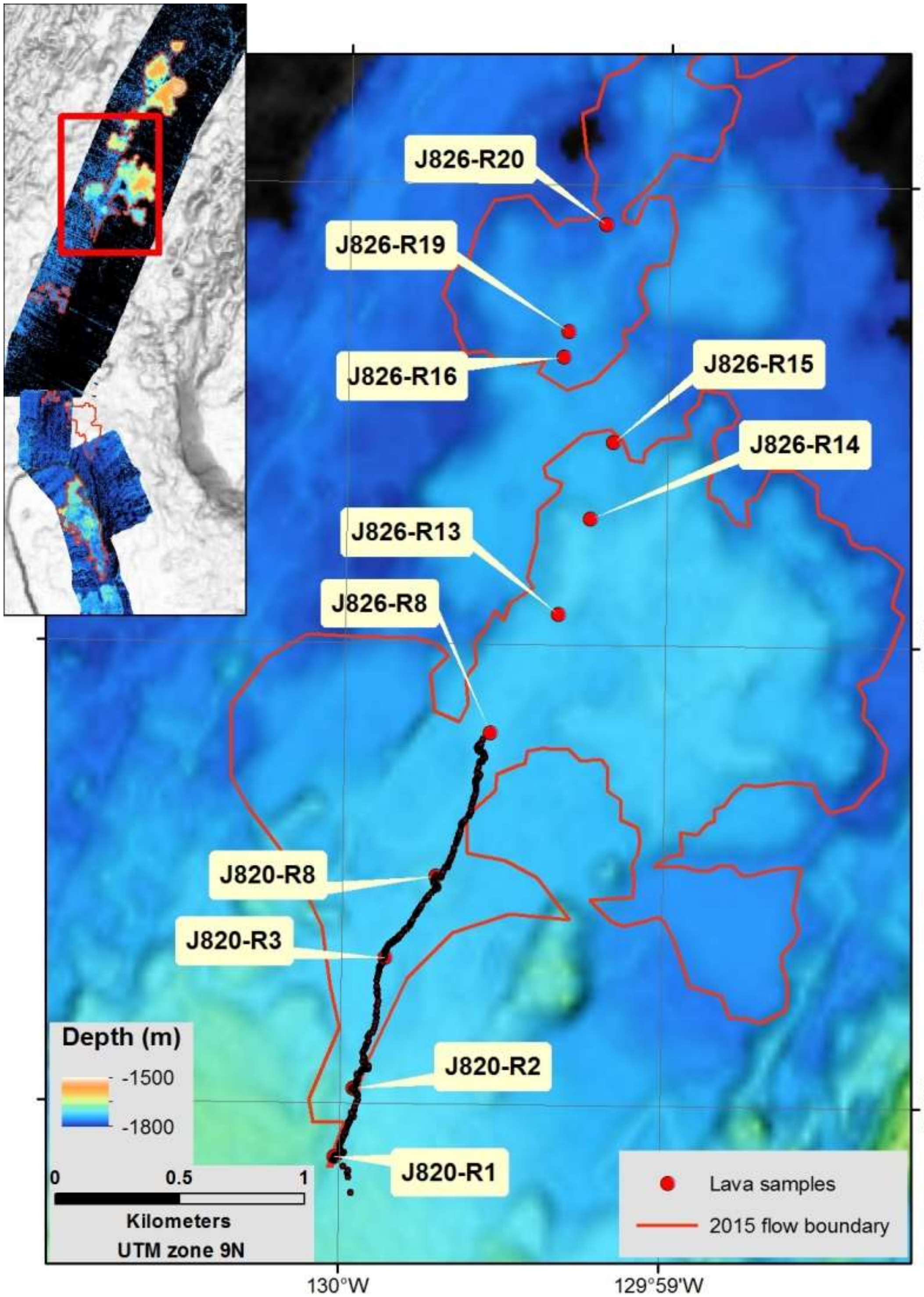

Figure 4.1.2-1 Map showing lava sample collection locations from ROV *Jason* dives J2-820 and J2-826 on the North Rift Zone of Axial Seamount. The flow boundaries (brown lines) were drawn to enclose differences between multibeam bathymetry collected before and after the April 2015 eruption, and still should be considered preliminary. Inset map: The extent of the dive map (red box) is shown on a map showing the differences between multibeam bathymetry data collected before and after the April 2015 eruption. The northern part is the difference between R/V *Thompson* data collected on cruises TN326 (July 2015) and TN300 (September 2013), with colors ranging from dark blue representing no change to orange representing 100 m vertical change. The southern part is the difference between TN326 data and MBARI Mapping AUV data collected in 2006 and 2007 (so also reveals the 2011 flows on the caldera floor), with colors ranging from dark blue representing no change to orange representing 18 m vertical change. The difference maps are superimposed on regional bathymetry in gray-scale.

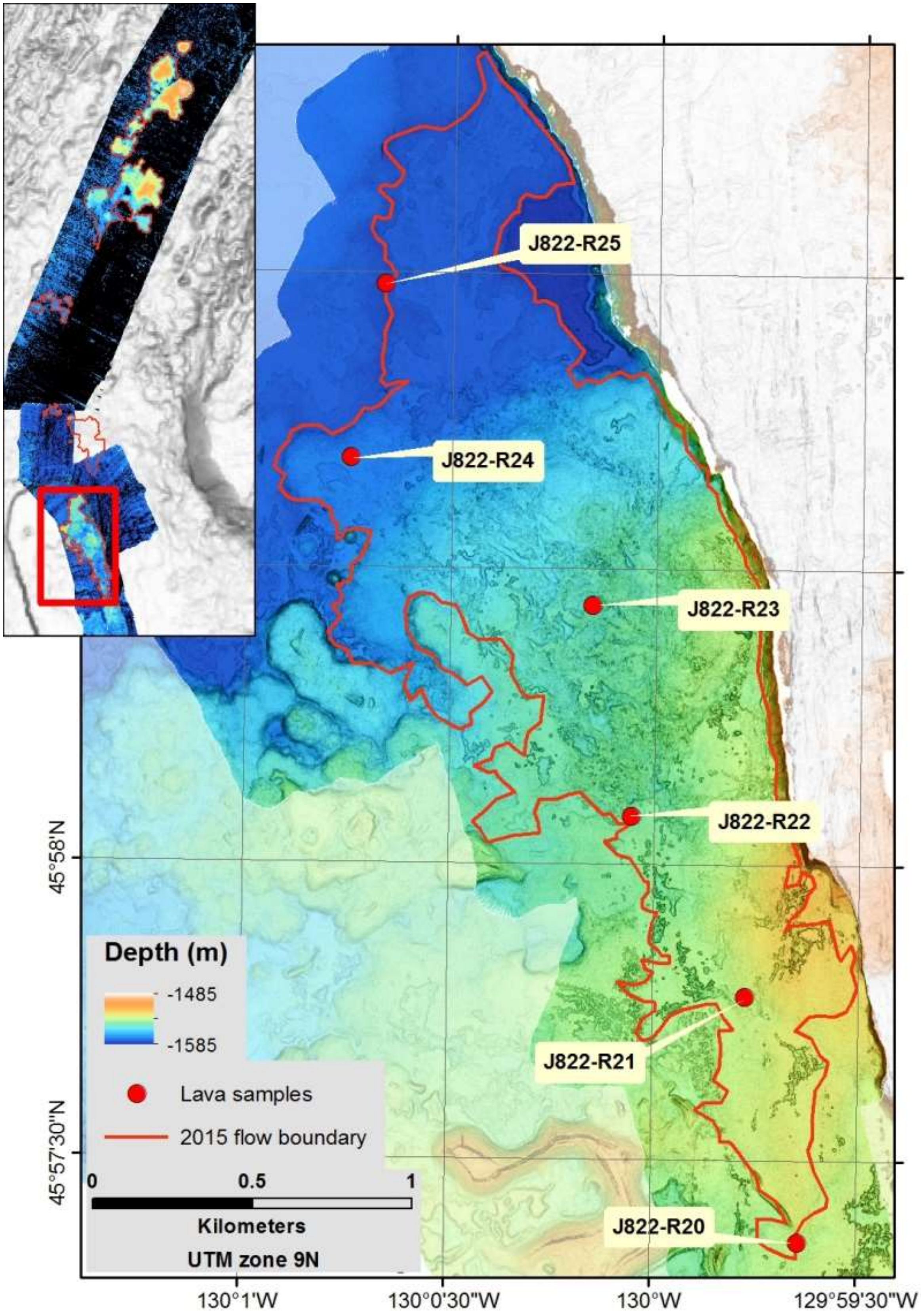

Figure 4.2.1-: Map showing lava sample collection locations from ROV *Jason* dive J2-822 on the northeastern caldera floor of Axial Seamount. Bathymetry data from AUV *Sentry* survey 338 is superimposed over MBARI AUV data collected in prior years, both at 1 m resolution. Flow boundaries and inset map as described for Figure 4.2.1-1.

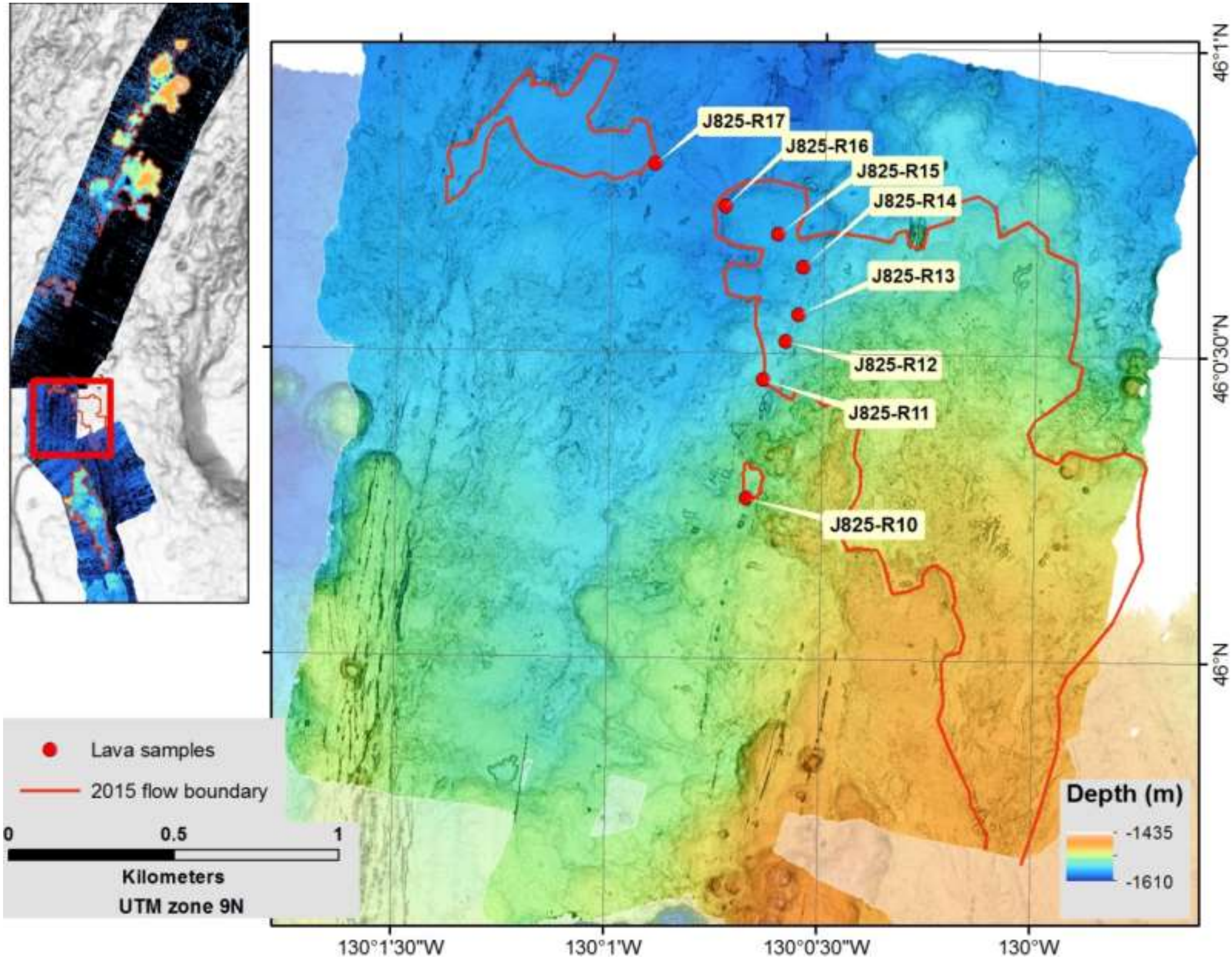

Figure 4.1.2-3 Map showing lava sample collection locations from ROV *Jason* dive J2-825 on the North Rift Zone of Axial Seamount. Bathymetry data from AUV *Sentry* Survey 341 is shown over MBARI AUV data collected in prior years. Flow boundaries and inset map as described for Figure 4.1.2-1.

Figure 4.1.2-4 Framegrab of sample J822-Geo-20 being held in the manipulator. Visible behind the sample is the contact between flows: small lobate pillows of fresh, glossy black lava of the 2015 flow in the foreground, and larger, sediment-dusted bulbous pillows of an older lava flow beyond.

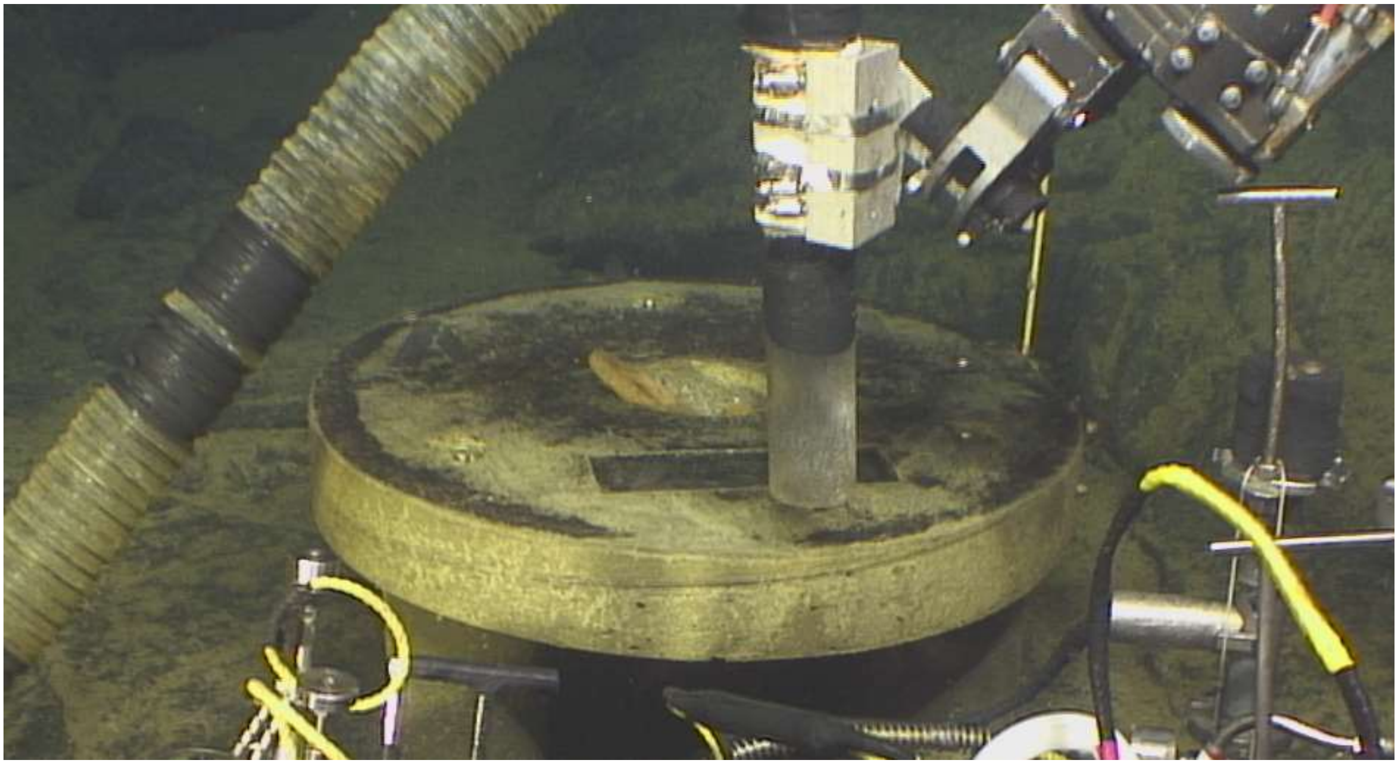

Figure 4.1.2-5 Framegrab of sample J823-Geo-01 being collected from the pressure measurement benchmark AX-101 in the central caldera. The suction sampler held in the manipulator is vacuuming the black particles of volcanic glass (ash), which was mostly limu o Pele, that had settled on the benchmark.

4.1.3 Self-Calibrating Pressure Recorder

Glenn Sasagawa, Scripps Institution of Oceanography

The Self-Calibrating Pressure Recorder (SCPR) is a seafloor bottom pressure recorder with an on-board pressure calibrator. This device is capable of measuring and correcting for the in-situ drift of quartz pressure gauges and thus delivering drift-free bottom pressure time series. The SCPR was first deployed on 7 Sept, 2013 (Cruise TN300), at location 45.93438° North, 130.01178° West, 1541 m depth.

An unsuccessful attempt was made to release the SCPR using a surface acoustic transponder on August 18, 2015. Additional surface communications using the data link acoustic modem were attempted on August 19; the depth of the instrument was beyond the stated range of the modem. The third attempt was made on August 23, using an underwater acoustic data modem on the JASON ROV, during dive J2-823. After some difficulty, the SCPR released its anchor and was recovered at the surface.

An initial review of the data showed valid operation for approximately 14 months. Useful pressure data spanned the interval from 7 Sept 2013 to 28 Feb 2015 (538 days). After this time, the valve connecting the gauges to the seafloor pressure failed in the closed position, likely due to depleted batteries, and the gauges could not measure seafloor pressure. During the deployment, 24 calibrations were performed at 20 day intervals. The calibration system began to fail after 6 Dec 2014, with low battery levels also suspected as to be the cause. The pressure gauges did record gauge temperatures during the entire deployment period, and recorded a temperature anomaly after the 2015 eruption. Recording system error contaminated the record of one of the two gauges after 30 Nov 2014; efforts are underway to correct the data set.

4.2 Hydrothermal Chemistry and Incubator Module

David Butterfield, Ben Larson, Kevin Roe, Ryan Wells

Summary of chemistry goals

Because Axial Seamount is the most robust magmatic/volcanic site on the Juan de Fuca ridge, the scientific community has chosen to make it a long-term observatory site to understand the evolution of hydrothermal processes and how they are influenced by the volcanic eruption cycle. Our group from PMEL, along with colleagues from University of Washington, Oregon State, Marine Biological Laboratory, University of Massachusetts Amherst and other institutions, have explored, sampled, and conducted experiments at Axial nearly every year since 1998. The chemistry group aims to understand what processes control the composition of hydrothermal fluids and their evolution over time, and to link fluid chemistry to geological and biological processes.

Our goals for this cruise were three-fold. 1. Continue the long-term time-series sampling of specific vent sites around Axial Seamount caldera. 2. Investigate and sample new lava flow areas that resulted from the April, 2015 eruption and install time-series monitoring instruments. 3. Conduct in-situ microbial growth experiments with the incubator instrument developed at PMEL and first tested in 2014. Funding for the first goal is provided by NOAA charter ship funds and salary support from PMEL. Funding for the second goal is from a NSF RAPID grant (OCE1546659) add additional NOAA ship and ROV support. Funding for the third goal is provided by a grant from the Moore Foundation Marine Microbiology Initiative.

Our team for this cruise included: Dave Butterfield, leader of the chemistry group and incubator project; Ben Larson, gas chromatography and incubator setup/operation; Kevin Roe, HFPS setup and shipboard sample analysis; Ryan Wells, incubator and HFPS engineering support. In addition to our PMEL group, Chris Algar, Begum Topcuoglu, Emily Reddington, and Jim Holden played important roles in getting the incubator set up, and took care of RNA filtration on HFPS. Nathan Buck and Rachel Spietz took charge of the CTD hydrothermal plume program, and were assisted by Ben Larson.

Long-term time-series sampling

As in previous years, we sought to maximize the number of vent sites sampled for time-series. Our targets included high-temperature (Inferno, Virgin, Hell) and low-temperature (Anemone) vents in the ASHES field, high-T anhydrite vents in the south (Vixen/Casper) and SE caldera (Trevi), high-T vents in the International District vent field (El Guapo, Diva, Castle), and diffuse vents in the SE caldera (Marker 113, Marker 33, Marker N3, Spanish Steps). We collected one Ti major sampler from a 290°C vent at CASM.

Exploration and sampling of the new lava flow on the North Rift Zone

Prior to the start of our cruise, the OOI Maintenance cruise, led by Deborah Kelley and Orest Kawka, conducted multibeam mapping to identify the NRZ lava flows and executed one ROV dive on what appeared to be the thickest lava flow, finding active hydrothermal venting there. We continued the exploration of the new lava flow with additional multi-beam mapping, water column plume surveys, ROV surveys and sampling of rocks and fluids. We collected fluids from four different sites on two distinct lava flows. We installed a time-series chemistry sampler in a 19-20°C vent on the NRZ, and a water-column MAPR mooring nearby to monitor changes in source chemistry and plume properties over the next year. Negotiations are ongoing to retrieve the time-series sampler in 2016.

Sampling instruments.

Our tools included titanium major samplers from WHOI, UCSB-type gas-tights from John Lupton and Marv Lilley, and the Hydrothermal Fluid and Particle Sampler. We were not set up to extract gas-tight samplers on board this year, so we were limited by the total number of pre-evacuated samplers available (10 total). We were limited by space to having 2 or 3 major samplers and 2 or 3 gas-tight samplers on each ROV dive. We had two dedicated dives for the HFPS using the incubator module, and one shared dive with the HFPS installed during the long dive to measure bottom pressure for geodesy, and a final short multi-purpose dive with HFPS to the North Rift Zone. Over the course of the expedition, we took 6 major samplers, 9 gas-tight samples, 8 samples for RNA analysis, 8 samples for *in-situ* incubation experiments, and 38 piston/bag samples with HFPS for chemistry. There was less dive time than hoped for because of poor weather and ROV repair time, but we nonetheless were able to collect a good set of samples for time-series chemistry around the caldera. Full details of the sample sites are given in the Jason Dive Sample tables section 6.5.

Oxygen Sensor on HFPS

Position 12 on the HFPS was dedicated to an in-situ Seabird (Bellevue, WA) 63 Optical Oxygen sensor. Measurements were taken by switching to valve position 12 and diverting fluid from the HFPS manifold through the O2 sensor. We did not use a pH sensor in 2015. The oxygen sensor on HFPS worked normally throughout the cruise.

Table 4.2-1 Summary of total hydrothermal chemistry samples collected.

Type	# of samples
Majors	6
GTB	9
HFPS bag/piston	38
RNA	8
Incubation	8

Notes on HFPS Performance

HFPS was installed on the first dive J2-820, to the North Rift Zone, but the flush pump failed at depth and we could not operate the sampler. Post-dive troubleshooting showed that the underwater cable joining the flush pump to HFPS PCU was severely corroded, and the pins on the pump housing were also dirty. We replaced the pump cable and cleaned up the pins on the pump. After testing the flush pump and spare, we kept the original flush pump (better volume accuracy and faster pumping). We had no further problems with the flush pump during the cruise. We replaced the sample pump with the spare sample pump following dive 824, after getting poor sample recovery. The spare sample pump worked much better for the last two dives. At the end of the very last dive, it was found that the HFPS intake hose had been cut near the titanium intake nozzle. We believe this happened after sampling was done, but will need to try to verify that from ROV video.

Sample Processing and Analysis

Vent fluid samples for water chemistry were collected from HFPS piston and bag samplers, incubator bag samples, and titanium major samplers. Ben Larson analyzed hydrogen and methane on an SRI 8610 gas chromatograph. 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 single syringe (60-ml, 120-ml, or 2-liter gas syringe), 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. Dave Butterfield analyzed pH (Ross Sureflow pH electrode with NBS buffers) and alkalinity (automated titration with Brinkmann Titrino and Brinkmann electrode). Samples were processed without exposure to air. 30ml bottles were filled slowly from the bottom to overflow and then capped with no head space for pH and alkalinity.

Kevin Roe analyzed hydrogen sulfide, dissolved silica and ammonia on board by spectrophotometry. Samples for dissolved silica were diluted to working analytical range in 0.02N HCl as needed, and kept refrigerated until analyzed. Hydrogen sulfide was measured by methylene blue spectrophotometry. Sub-samples for major elements were filtered through a 0.2 micron syringe filter and stored with no head space in 30ml hdpe bottles. Trace metal samples were transferred to I-Chem hdpe bottles and acidified with ultra-pure HCl (2 microliters/ml). Sulfur isotope samples were stored in 40ml vials with no headspace and 0.5ml of 10% solution of cadmium acetate.

When sample volume was limiting, priority was given to gas, shipboard chemistry, major elements and trace metals.

Sub-samples were taken for cell counts and microbiology experiments on board. In some cases, all, or nearly all of selected water samples went to Jim Holden for on-board culture experiments. Sub-samples for nitrate/nitrite/phosphate analysis on shore were filtered, acidified to pH ~3, purged with N2 gas to remove H2S and then frozen. Selected samples were filtered and frozen in glass bottles (previously baked at 550C for 6 hours) for Dissolved Organic Carbon analysis. Analysis will be done by the Butterfield lab, except for cell counts by the Holden lab.

Gas-tight samples will be analyzed on shore for He, CO2, H2, CH4 and other gases in the laboratories of Dr. John Lupton (PMEL-Newport) and Dr. Marv Lilley (U.W.).

Our shore-based analytical plan for HFPS 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. Nutrient samples (filtered, acidified, and purged with nitrogen) will be analyzed by either the PMEL nutrient lab or the UW nutrient lab. DOC will be analyzed on selected samples from each vent site.

In addition to processing the samples we collected during this cruise, Kevin Roe also processed the RAS time-series samples recovered in July during the OOI cruise. These samples were first processed on the OOI cruise by Brendan Phillip, Orest Kawka, and Eric Olson. They measured pH and dissolved gases. Kevin measured alkalinity, ammonia and silica during our cruise, and froze aliquots for nitrate/nitrite/phosphate analysis on shore. Our lab will analyze these samples and create a chemistry database for OOI.

HFPS Incubator Module

The newest component of the HFPS, the incubator module, was developed specifically for the Subseafloor Life project, and it represents the most significant expansion of HFPS capabilities since construction of the first prototype over 15 years ago. The incubator was designed and built at PMEL. The main components of a single incubator unit (Fig. 4.2-1) consist of an insulated bottle (shown in purple), which hosts the sample bag and heating rod, a final bottle (shown in silver), which also contains a sample bag, and a titanium shutoff valve situated between the HFPS manifold and incubator bottle.

The incubator is designed to pull in vent fluid using the same intake line, pumps and manifold that are part of the original HFPS framework (described in more detail below). Additional reagents and ^{13}C labeled HCO_3 are loaded with the sample into a thick Kynar bag. Once the bag is filled, the shut off valve is closed to prevent further intake from the manifold. A temperature controller housed in a separate titanium case records incubator temperature from a RTD thermistor situated next to the bag, and maintains a constant temperature at a set point (within ~1 °C) by supplying current to the heating rod inside the incubator based on the thermistor temperature.

Once the incubation has been allowed to run for a pre-determined time, the incubated fluid is pumped from the incubator bag to the final sample bag through a 0.22 micron filter in a housing with a preservative reservoir containing “RNA-Later” (concentrated solution of NH_4SO_4). The filter is the primary result of the experiment and is saved for shore-based analysis in the Huber lab. The incubated fluid was saved for both shipboard and land-based analyses. The remaining liquid in both the incubator and final bottles (make-up liquid surrounding the bags and pumped out during operation to create suction at the bag intake) was also sampled for diagnostic purposes. The chemistry of all incubated fluids and control samples will be determined after the cruise.

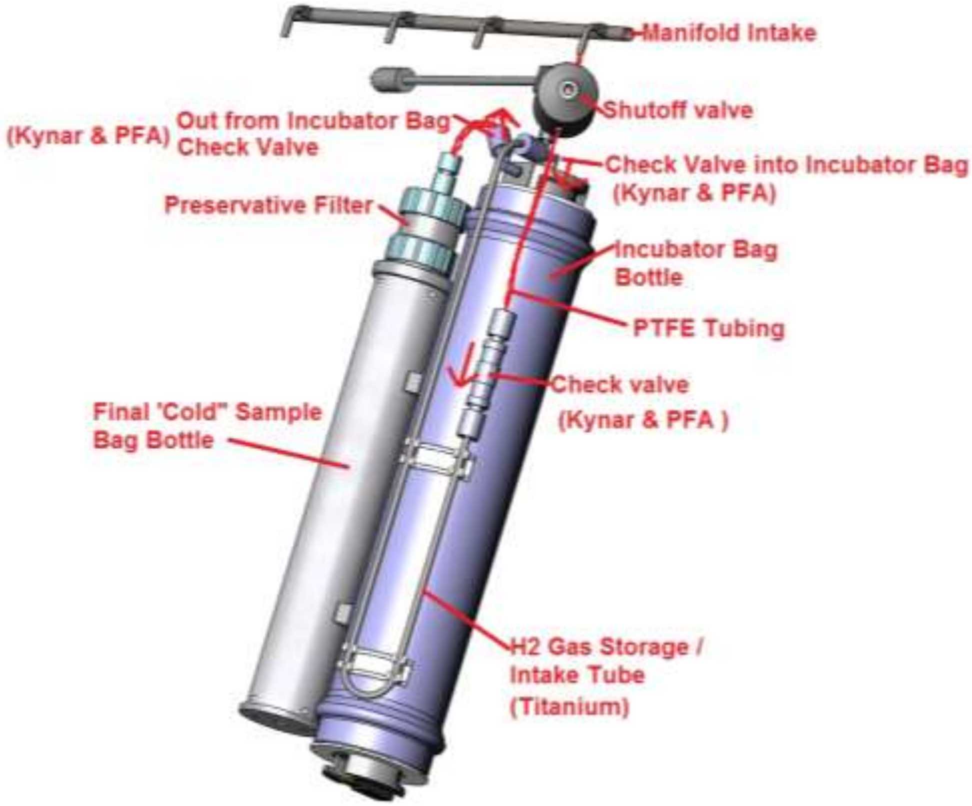

Fig. 4.2-1 Single incubator unit; 4 units fit on one rack

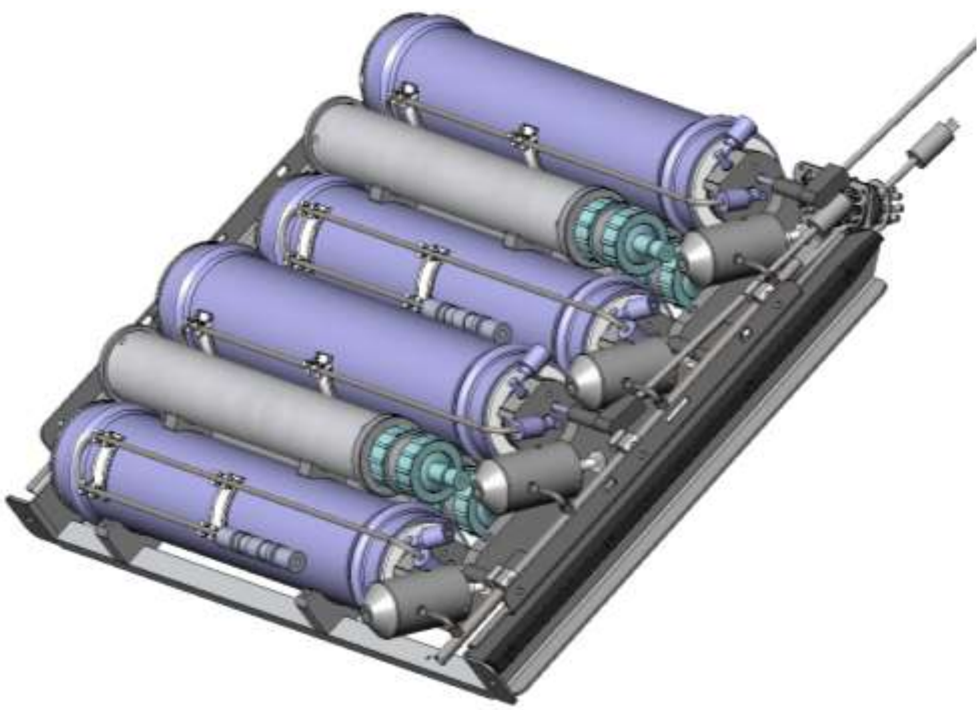

Fig. 4.2-2 Incubator rack, fully loaded and isolated from HFPS frame

Four incubator units can be loaded onto a single rack, (Fig. 4.2-2), allowing for two separate experiments per dive. Each experiment uses 2 units; one loaded with labeled $^{13}C\ HCO_3$ and a control loaded with $^{12}C\ HCO_3$. Based on results from previous years, our strategy in 2015 was to perform replicate experiments at a single site (Marker 33 vent) at 55°C, with two time points per dive (approximately 12 and 18 hours).

Problems encountered in the first deployments of 2014 were eliminated and the incubator appears to have operated exactly as intended this year. This is extremely satisfying, and shows that we have a good design and solid engineering and execution. In 2014, a minor ground fault only allowed us to run two out of the four heated chambers during a dive. This ground fault, related to the internal insulation in the heater rods, was eliminated by unsealing the heating element, heating the surrounding insulation at 100° for 3 days, then resealing the element and insulation, and pressure testing the resealed rod. This process drove out residual moisture and allowed us to run all four heaters at will during the 2015 deployments. Fluid transfer was also a problem in 2014. We re-designed sample bags to improve sealing of the fittings, and determined during pre-dive testing that the bags would seal themselves off during the final fluid transfer out of the primary bag. The solution was to install a perforated Teflon PFA straw through the outlet fitting into the primary incubation bag. In combination with strict attention to all plumbing details, the addition of the straw gave us good fluid transfer. More details of the incubator experiments are given below.

Hydrothermal Fluid Particle Sampler Configuration (HFPS)

Because the configuration of HFPS can change from year to year, we provide some details of how it was set up. Four incubator units can be loaded onto a single rack, (Fig. 4.2-2), allowing for two separate experiments per dive. The incubator rack is paired with a sample rack that can accommodate up to 9 additional samples (Fig. 4.2-3). The standard HFPS intake nozzle was used without any additional attachment/adapter for both incubator and non-incubator configurations.

The incubator module necessitated a different valve configuration. Each incubator unit required 3 valve positions such that when the incubator was fully loaded, 12 valve positions were dedicated to this module. See the table below for HFPS valve assignments used to affect the three incubator functions of initial filling with sample, transferring and preserving the incubated sample, and shutting off the incubator intake (and simultaneously opening the pathway to preserve the sample).

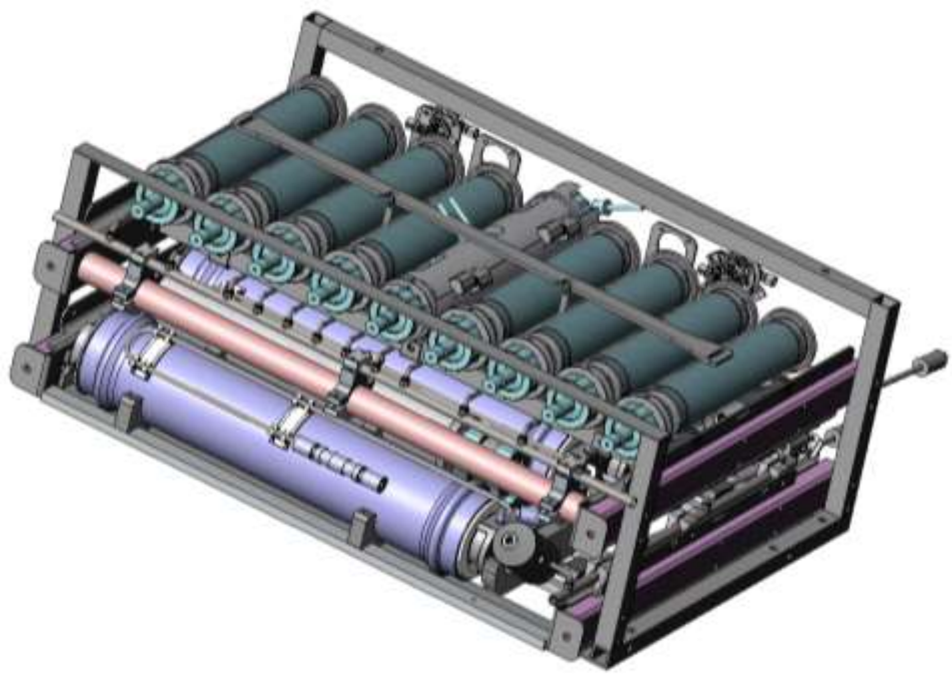

Fig. 4.2-3 Assembled HFPS with sample rack on top, and incubator rack on bottom

Table 4.2-2 HFPS and Incubator Valve Assignments in 2015

HFPS Valve #	Function w Incubator	Function w/o Incubator
1	4-L bag (LVB)	4-L bag (LVB)
2	Unfiltered piston	Unfiltered piston
3	Filtered piston	Filtered piston
4	Unfiltered piston	Unfiltered piston
5	Filtered piston	Filtered piston
6	Unfiltered piston	Unfiltered piston
7	Unfiltered bag	Filtered piston
8	Unfiltered bag	Unfiltered piston
9	Unfiltered bag	Filtered piston
10	RNA filter	RNA filter
11	RNA filter	RNA filter
12	O2 sensor	O2 sensor
13	Fill Inc 1	RNA filter
14	Transfer Inc 1	RNA filter
15	Fill Inc 2	RNA filter
16	Transfer Inc 2	Unfiltered bag (LVB on J824)
17	Fill Inc 3	Filtered bag
18	Transfer Inc 3	Unfiltered bag
19	Fill Inc 4	Filtered bag
20	Transfer Inc 4	Unfiltered bag
21	Shutoff Intake Inc 1	Filtered bag
22	Shutoff Intake Inc 2	Unfiltered bag
23	Shutoff Intake Inc 3	Unfiltered bag
24	Shutoff Intake Inc 4	Unfiltered bag

The incubator module was installed two dives (822 and 825) so the 12 valve positions from 13-24 were assigned to the incubator on those dives, leaving valve positions 1-12 for normal HFPS samples for chemistry and microbiology. We set up a tray of mixed pistons, bags, and RNA filters for incubator dives. Valve position 1 was always assigned to the large volume bag (4-liter) used for microbiology experiments on board (Stable Isotope Probing, or SIP). Valve positions 2 through 6 were assigned to piston samplers. We used a combination of titanium pistons with all-Teflon inlet caps and PVC pistons. Valve positions 7 through 9 were assigned to bag samplers. Valve positions 10 and 11 were assigned to 47mm diameter, 0.2 micron pore size, flat membrane filters in McLane 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. Valve position 12 was assigned to the SBE63 Oxygen sensor. The valve assignments for non-incubator dives are given in Table 4.2-2. Note that we added a second 4-liter LVB in position 16 on dive 824. Plumbing to LVBs and also to the O2 sensor did not go through the multi-port quick-connect fittings.

Incubator Temperature Records

The following plots show the recorded incubator temperatures for both deployments. All 4 chambers were heated on each dive. The plots show the entire duration of the incubations. Red and green lines indicate thermocouple and circuit board set points, respectively. Blue and black data points indicate measured thermocouple and circuit board temperatures, respectively.

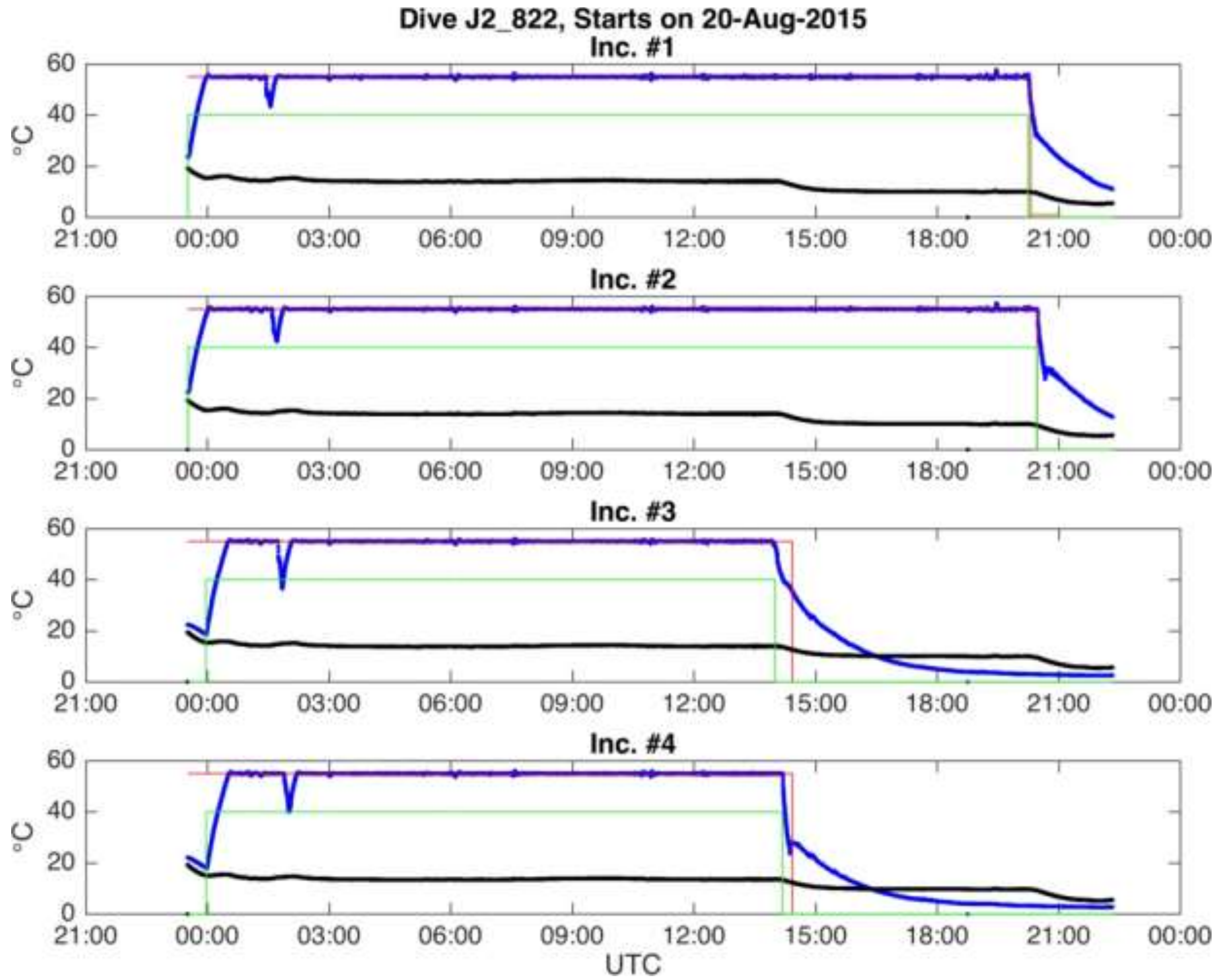

Figure 4.2-4 Temperature record for Jason Dive 822 at Marker 33. All positions heated to 55 °C.

Both thermocouple and circuit board measured temperatures must be lower than their respective set points for current to flow to the heating element. Thus, the heaters can be turned off by lowering the circuit board or thermocouple set point. A dip in measured thermocouple temperature (blue dots) indicates intake of fluid that is cooler than internal incubator water (diffuse fluid typically comes in at <40 °C), and so marks the beginning of the incubation.

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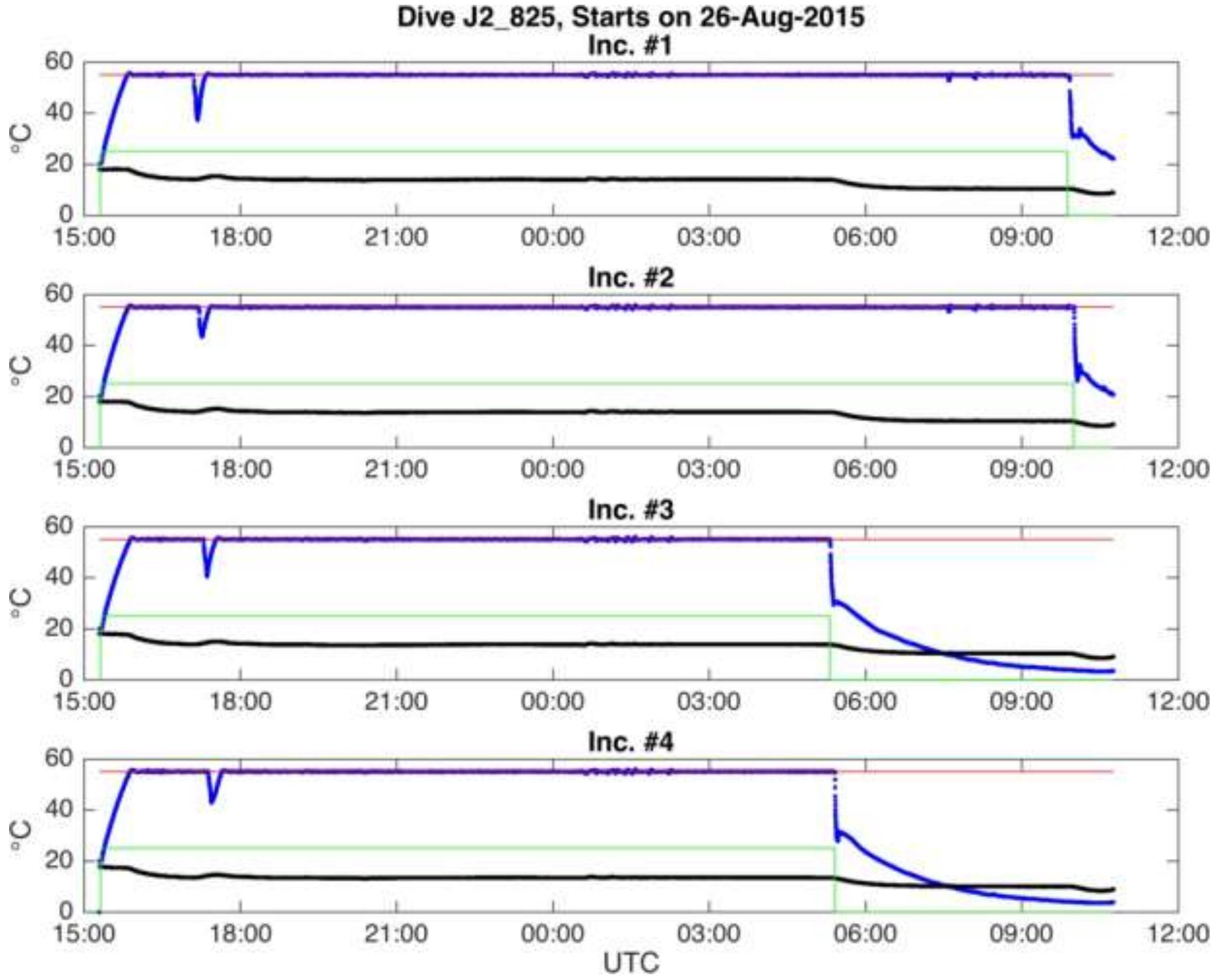


Figure 4.2-5 Temperature Record for Jason Dive 825 at Marker 33. All Positions heated to 55 °C.

Table 4.2-3 summarizes the incubator experiments. The mass of the final bag indicates how much incubated sample was pulled through the RNA preservative filter at the end of the incubation. In general, the final bags were full or nearly full, and the primary incubator bags were empty or nearly empty.

We routinely observed high H_2 concentrations in all final incubator samples (with the bulk of samples ranging from 100-300 uM) owing to the addition of a pocket of H_2 gas at the beginning of an incubation. Conversely, most incubator samples exhibited fairly low CH_4 concentrations (concentrations not yet calculated) compared to coincident fluid samples, possibly reflecting a low rate of autotrophic CH_4 production, or a high rate of heterotrophic CH_4 consumption.

Table 4.2-3: Incubator Experiment Summary

J2-822	**Mrkr 33**						
Incubator ID	**Setpoint**	**Start (UTC) On 8/21/2015**	**Stop (UTC) On 8/21/2015**	**Duration (hours)**	**Mass of final bag (g)**	**Mass in primary bag (g)**	**pH of incubated fluid F=final, 1°=primary**
1 (^{12}C)	55	1:45	20:16	18.5097	685	0	6.18F
2 (^{13}C)	55	1:54	20:28	18.5625	620	180	6.16F, 5.95 (1°)
3 (^{12}C)	55	2:07	13:59	11.8778	406	0	6.08F
4 (^{13}C)	55	2:14	14:12	11.9653	700	0	6.20F
							pH 5.59 in bag 8
J2-825	**Mrkr 33**						
Incubator ID	**Setpoint**	**Start (UTC) On 8/26/2015**	**Stop (UTC) On 8/27/2015**	**Duration (hours)**	**Mass of Final bag (g)**	**Mass in primary bag (g)**	**From final bag**
1 (^{12}C)	55	17:22	9:55	16.5514		65	6.00
2 (^{13}C)	55	17:26	10:00	16.5694	815	27	6.00
3 (^{12}C)	55	17:32	5:19	11.7847	785	0	5.98
4 (^{13}C)	55	17:39	5:24	11.7597	767	125	5.90

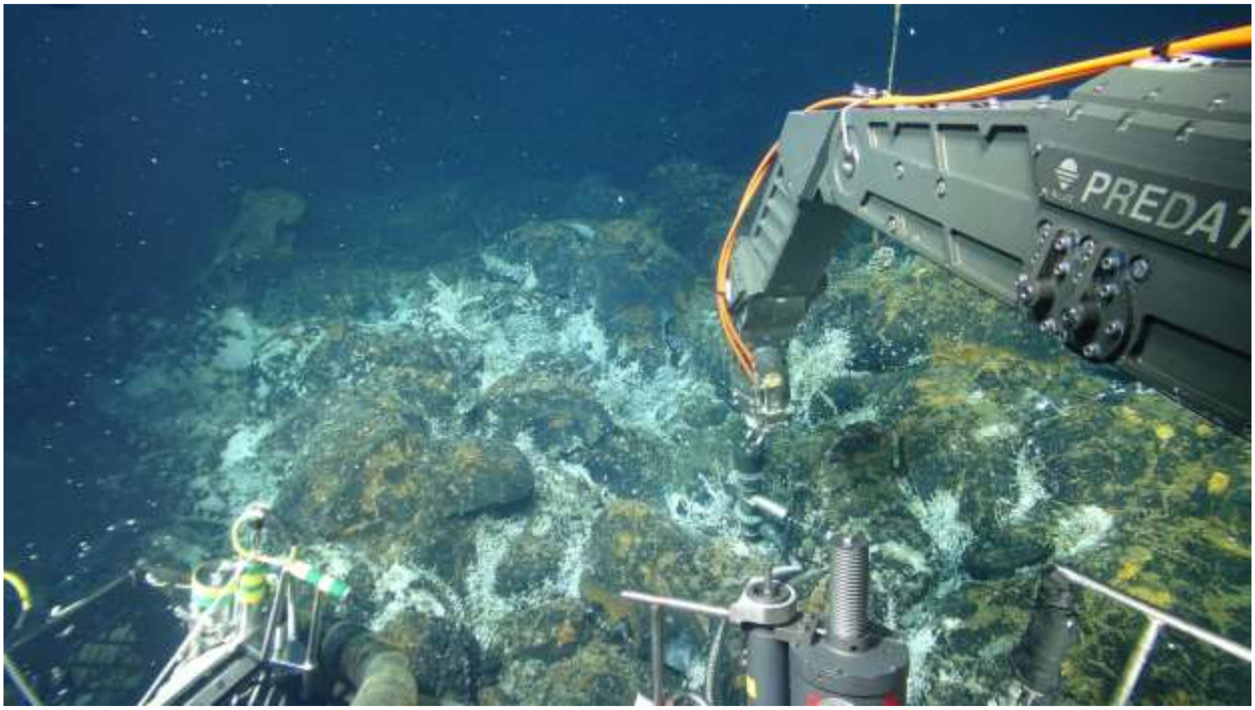


Figure 4.2-6 HD photo of Marker 33 Vent, where all of the incubator experiments were done. Temperatures were ~34C on dive 822 and 40C on dive 825.

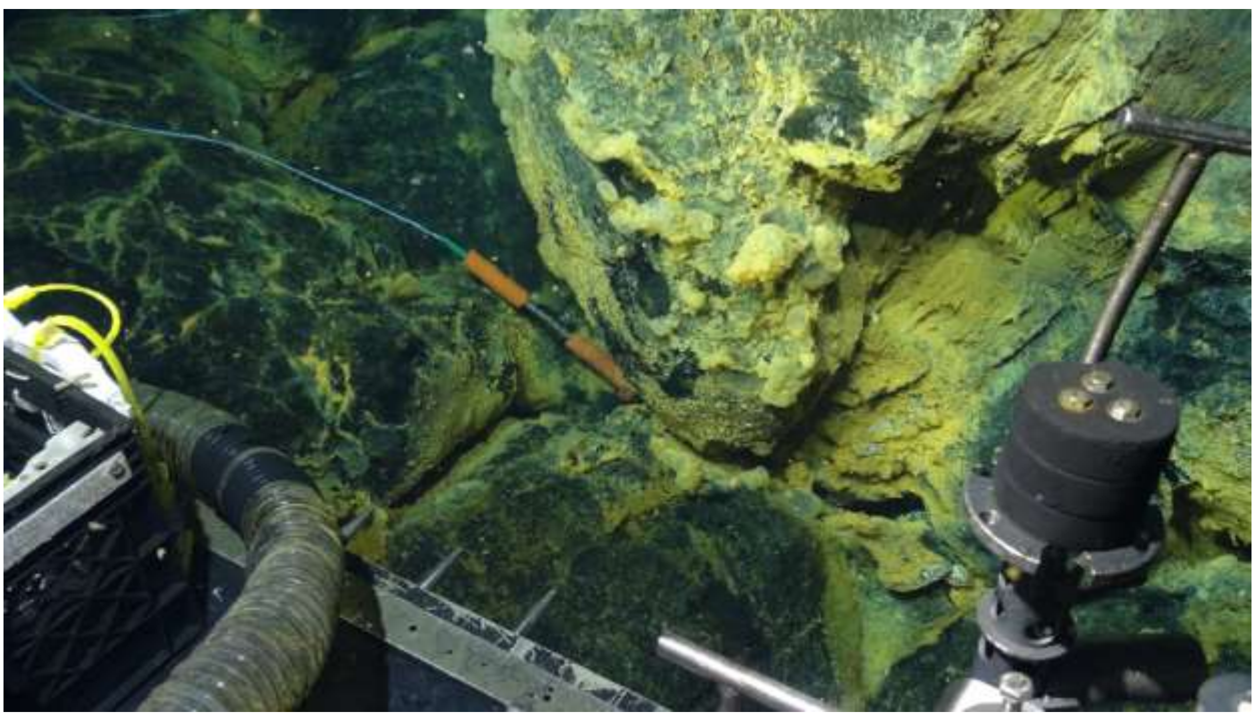


Figure 4.2-7 Low-T vent with orange microbial mat and mucopolysaccharides globules on NRZ new lava flow. RAS intake with temperature recorder installed in crevice, where temperature was 19-20C.

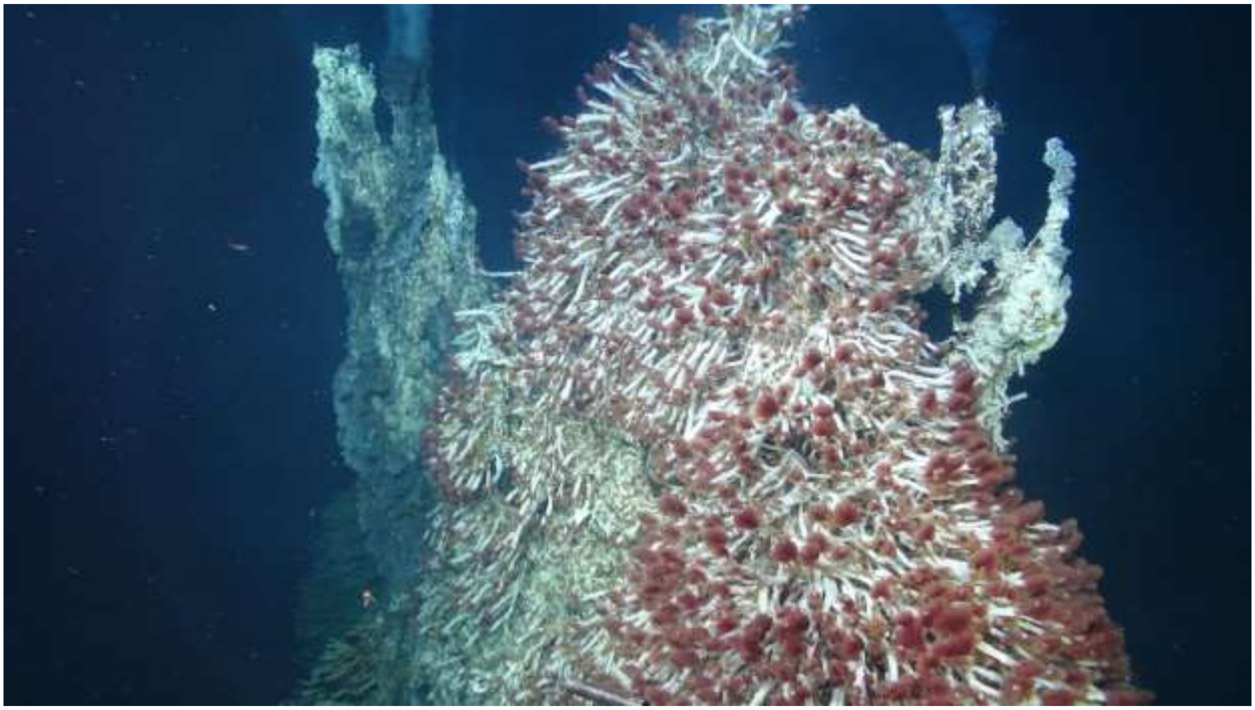


Figure 4.2-8 290°C sulfide chimney at CASM (T&S vent), sampled with Ti major sampler on dive 822. The vent appears very similar to when it was sampled in 2007.

Figure 4.2-9 Top of El Guapo chimney sampled on dive 822. Maximum temperature measured was 323C.

Table 4.2-3: UCSB Titanium Gas-tight and Ti Major Sub-samples for Gas Analysis

Dive	GTB	Sub-sample flask ID	Vent	Vent T	[gas] mmole/kg	GTB tape colors	Dive Sample #
J2-820	white MAJ	flask 15	NRZ	20.9	3.35		J820-Major-04
J2-822	white MAJ	flask 19	CASM	291	40.9		J822-Major-26
J2-826	red MAJ	flask 673	Snowdrift NRZ	5.6	2.23		J826-Major-18
J2-820	gt11		NRZ	20.9	4.25	silver	J820-GTB-05
J2-820	gt17		NRZ	19.6	3.48	white	J820-GTB-07
J2-822	gt18		ElGuapo	318.8	98.9	blk/wht/orange	J822-GTB-11
J2-822	gt6		Diva	275.4	310	yellow	J822-GTB-15
J2-822	gt9		Castle	251.5	114	red	J822-GTB-19
J2-824	gt2		Trevi	241.1	6.66	green	J824-GTB-12
J2-824	gt5		Virgin	200.5	230	black	J824-GTB-06
J2-824	gt7		Vixen	326.4	85.0	red/green	J824-GTB-21
J2-826	gt12		NRZ	35.4	8.42	green/yellow	J826-GTB-12

4.3 Microbiology

Thermophilic Biogeochemical Processes

Jim Holden, University of Massachusetts (Amherst) / Julie Huber, Marine Biological Laboratory / Bob Morris, University of Washington

There was a large contingent of microbiologists participating in and associated with this expedition with the broad goals of 1) determining the effect of the April 2015 eruption on seafloor and water column microbes and viruses, 2) determining the effect of in situ pressure on microbial growth and gene expression and virus production, 3) determining the rates, constraints and protein expression patterns of various functional groups of microbes, and 4) culturing new microbes from the subseafloor and hydrothermal plume. Hydrothermal and near-bottom fluids were collected by *Jason* II from five sites for microbiological studies: Marker 33 (2x), Marker 113, Anemone, Marker 294 along the north rift zone eruptive pillow mounds associated with the 2015 eruption (2x), and Marker 261 also on a separate north rift zone eruptive pillow mound. Hydrothermal plume samples were collected using vertical CTD casts at six sites: ASHES, International District, Vixen/Casper, CASM, central caldera, and background seawater. The following is a list of analyses performed on the collected samples:

- Replicate in situ incubation of diffuse hydrothermal fluids from Marker 33 at 55°C for 12 and 16-18 hours with stable isotope probing (SIP) experiments for community and gene expression analyses, cell culturing, viral counts, and fluid chemistry analyses.
- Shipboard SIP experiments at 55°C from Marker 33 (2x) and Marker 113, and at room temperature and 4°C from background seawater and the hydrothermal plume with concomitant viral enumeration.
- ^{13}C uptake rate experiments at 80°C, 55°C and 30°C from Marker 33 (2x), Marker 113, background seawater, and the hydrothermal plume.
- ^{13}C uptake experiments at 55°C from Marker 33 for nanoSIMS analysis.
- DNA and RNA filter samples from Marker 33 (2x), Marker 113, Anemone, the north rift zone, near-bottom seawater at Marker 113, the hydrothermal plume over ASHES and background seawater for metagenomic (community analysis) and metatranscriptomic (gene expression) profiles.
- Sample preservation for single-cell genomics from Marker 33 (2x), Marker 33, background seawater, and the hydrothermal plume.
- Estimates of the concentrations of methanogens, autotrophic sulfur reducers and heterotrophs that grow at 80°C and 55°C from Marker 33 (2x), Marker 113, Anemone, and the north rift zone new eruption site, as well as the total number of microbes in the sample.
- Microcosm experiments to determine if thermophilic and hyperthermophilic methanogens and heterotrophs grow cooperatively when H_2 concentrations are too low to support methanogen growth.
- Hydrothermal plume and background (outside of caldera) water samples for proteomic protein expression analysis collected via CTD from ASHES, and International District.
- Cell culturing for novel thermophilic and hyperthermophilic microbes from hydrothermal fluids and mesophilic sulfur oxidizers and methylotrophs from hydrothermal fluids and plume water.
- Mat samples collected from the north rift zone eruptive pillow mounds for microscopic and elemental analyses as well as cell cultures for mesophilic microbes.
- Near-bottom seawater was collected from Marker 113 for microbe-particle association studies and for the detection of protozoa.
- Samples were collected by members of the labs of Jim Holden (UMass), Julie Huber (MBL) and Bob Morris (UWash) on board the ship for their own uses as well as for the labs of Lisa Zeigler (Ventner Institute), Kim Juniper (UVic), and Pete Girguis (Harvard).

There was extensive diffuse flow associated with the 2015 eruptive pillow mounds on the north rift zone and extensive coverage of brown bacterial mat on the surfaces of the pillow mounds. There was no new hydrothermal venting or bacterial mats associated with the 2015 lava flow in the NE caldera. The only ‘snow blower’ new eruption vent found was on top of the northern-most eruptive pillow mound on the north rift zone (Marker 261). Previous diffuse vents sites such as Marker 33, Marker 113, Anemone and Boca appeared to be largely unaffected by the eruption. We successfully incubated hydrothermal fluids in situ from Marker 33 at 55°C on two occasions.

4.4 CTD Operations

Nathan Buck, University of Washington Joint Institute for the Study of the Atmosphere and Ocean

CTD operations were conducted during the Axial Seamount 2015 research cruise aboard the R/V Thompson to address three main objectives. First, locate new hydrothermal sources that may have resulted from the April 2015 eruption event. Second, attempt to characterize the size and chemistry of any resulting plumes. Third, sample plumes originating from known areas of hydrothermal venting to determine how their compositions reflect the most recent eruption.

During this cruise a total of 8 CTD casts were conducted – four tow-yos and four vertical casts. Tow tracks and vertical cast locations are detailed in Figure 4.4-1. The equipment used for continuous sampling was provided by the R/V Thompson and consisted of a SBE911 plus CTD and included dual SEBE03 temperature sensors, dual SBE04 conductivity cells, dual SBE43 oxygen sensors and a Valeport VA500 altimeter. Additionally, PMEL supplied auxiliary sensors for optical light backscatter (LBS) and oxidation-reduction potential (ORP). Water samples using 10 liter niskin bottles with internal springs were taken at select depths, chosen based on plume absence or presence as indicated by light backscatter (dNTU) and ORP intensity. Niskin bottles were subsampled for the following: Helium isotopes, methane, hydrogen, dissolved inorganic carbon, nutrients, pH, microbiology, total suspended material, dissolved metals and total dissolvable metals. Cast types, locations, durations and sample inventories are summarized in **Table 4.4-1 (below).**

Lat (deg)-N	Lat (min) N	Long (deg) W	Long (min) W	Start time	End time	pH	3He	H2&CH4	CO2	Nuts	TDMe	DMe	XRF	Bio - Spietz	Comments
46	16.4334	-129	47.7288	15-Aug-2015 22:43	16-Aug-2015 00:49	23	17	9	11	17	17			6	Background cast (Large volume samples were collected for for Holden Lab and R. Spietz)
46	8.0784	-129	57.4212	18-Aug-2015 05:37											
46	3.3804	-130	0.2892		18-Aug-2015 11:34	19	14	11		14	14			10	Tow over North Rift Zone new lava flows (N->S)
45	55.0360	-129	59.5740	19-Aug-2015 00:43	19-Aug-2015 02:11	20	11	6	7	11	11	3	3	6	"Vixen" vent site
45	56.0140	-130	0.8200	19-Aug-2015 05:12	19-Aug-2015 06:35	8	5	5	5	8	5			6	"ASHES" vent site (Large volume samples were collected for for Holden Lab and R. Spietz)
46	0.8100	-130	1.3302	20-Aug-2015 03:49											
46	56.5056	-129	59.2272		20-Aug-2015 09:27	22	16	8	5	16	16				Tow into Axial caldera (N->S)
45	55.5780	-129	58.7994	20-Aug-2015 20:05	20-Aug-2015 21:17	13	9	6	5	9	9	1	1	6	"International District" vent site (Large volume samples were collected for for Holden Lab and R. Spietz)
46	1.2564	-130	0.4758	24-Aug-2015 12:41											
45	58.4064	-130	1.0398		24-Aug-2015 15:50	3				3	3				Tow over new lava flow NE of caldera rim (N->S)
46	0.7728	-130	1.2564	26-Aug-2015 05:05											
46	4.4052	-129	59.6556		26-Aug-2015 09:40	20	14	10	6	14	11				Tow along North Rift Zone (from caldera rim - completes transect with T15A-01 and T15A-02) (S->N)

We combined CTD tows T15A-01, T15A-02 and T15A-04 to construct a complete water column survey over the Northern Rift Zone (NRZ; Figures 4.4-1 and 4.4-2). Plume anomalies with significant LBS signals >0.01 dNTU) were ubiquitous along the transect for nearly the entire length of the NRZ and varied in intensity and extent. Tow T15A-01, which comprises the northernmost segment of the survey and covers the northernmost area of the new lava flows created during the April 2015 eruptive event, had LBS anomalies from the seafloor to a minimum depth of 1500 m with a maximum dNTU of 0.258. Additionally, regions of reduced hydrothermal chemicals were commonly found during the tow (ΔE= -100 mv), especially in the northernmost area**.**

Tow T15A-04 represents the middle section of the survey and had LBS anomalies that extended from the seafloor to a depth of 1360 m. This tow only surveyed two comparably smaller areas of new lava. The southernmost lava flow is overlain by a water column signal with a strong ORP signal (ΔE= -100 mv) and increased backscatter ($dNTU_{max}$= 0.1022).

Tow T15A-02 runs from just north of the caldera rim into the caldera and parallel to the east caldera wall over the southernmost lava flows. Again, dNTU anomalies were found over the entire seafloor reaching to a minimum depth 1350m. The strongest backscatter response occurred within the caldera with a large segment, over 4 km long, where dNTU > 0.12. In addition to increased backscatter there were also several small (ΔE = -25 mv) ORP responses within the caldera.

CTD tow T15A-03 (Figure 4.4-3) was conducted over the axial caldera rim and another area of new flow located to the northeast corner of the caldera. As with the NRZ survey, plume anomalies were prevalent. Notably there were areas of more intense LBS (dNTU > 0.1) and ORP response (ΔE= -100 mv) located in close proximity to the areas of fresh lava flow.

Four vertical casts were also conducted. Specifically, Vixen (V15A02), Ashes (V15A03) and the International District Vent Field (V15A04) were sampled and a background cast (V15A01) was made for comparisons to ambient seawater. T-S diagrams, a useful and easy way to characterize water masses as well as the strength of stratification, from the four casts can be found in Figure 4.4-4. Plots of LBS, ORP (Eh), and the time differential of ORP (dmV/dt) can be found in Figure 4.4-5. The derivative of voltage with respect to time was computed to mitigate the impact of a shifting baseline that occurs as a result of drift and hysteresis effects. By making this computation over 5 second time scales rapid changes in voltages appear as negative peaks and allow for comparisons of absolute voltages between and within casts. Plumes with significant LBS and ORP anomalies were found at all three sites when compared to background.

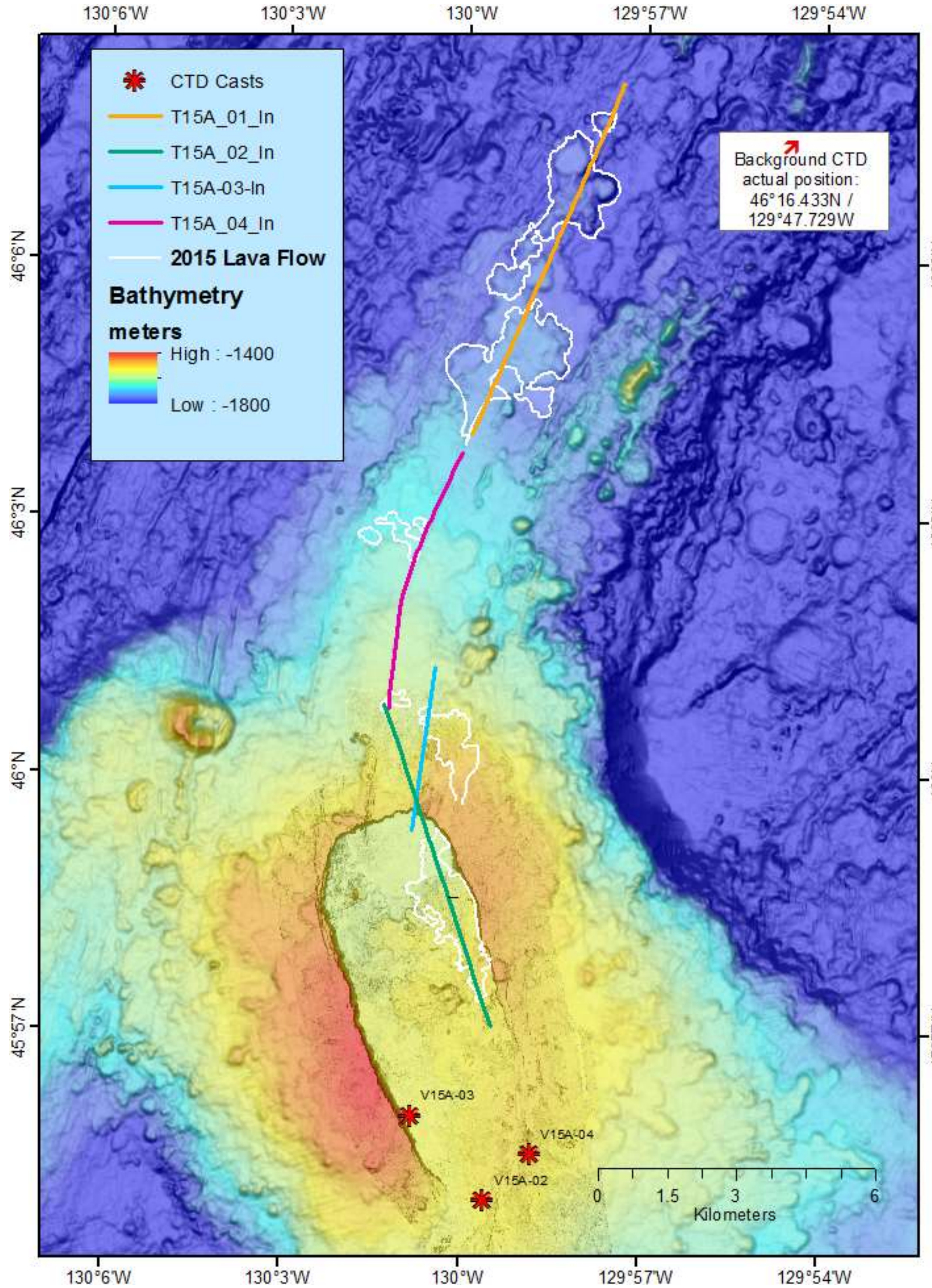


Figure 4.4-1 CTD operations for Axial 2015. Figure courtesy of A. Bobbitt

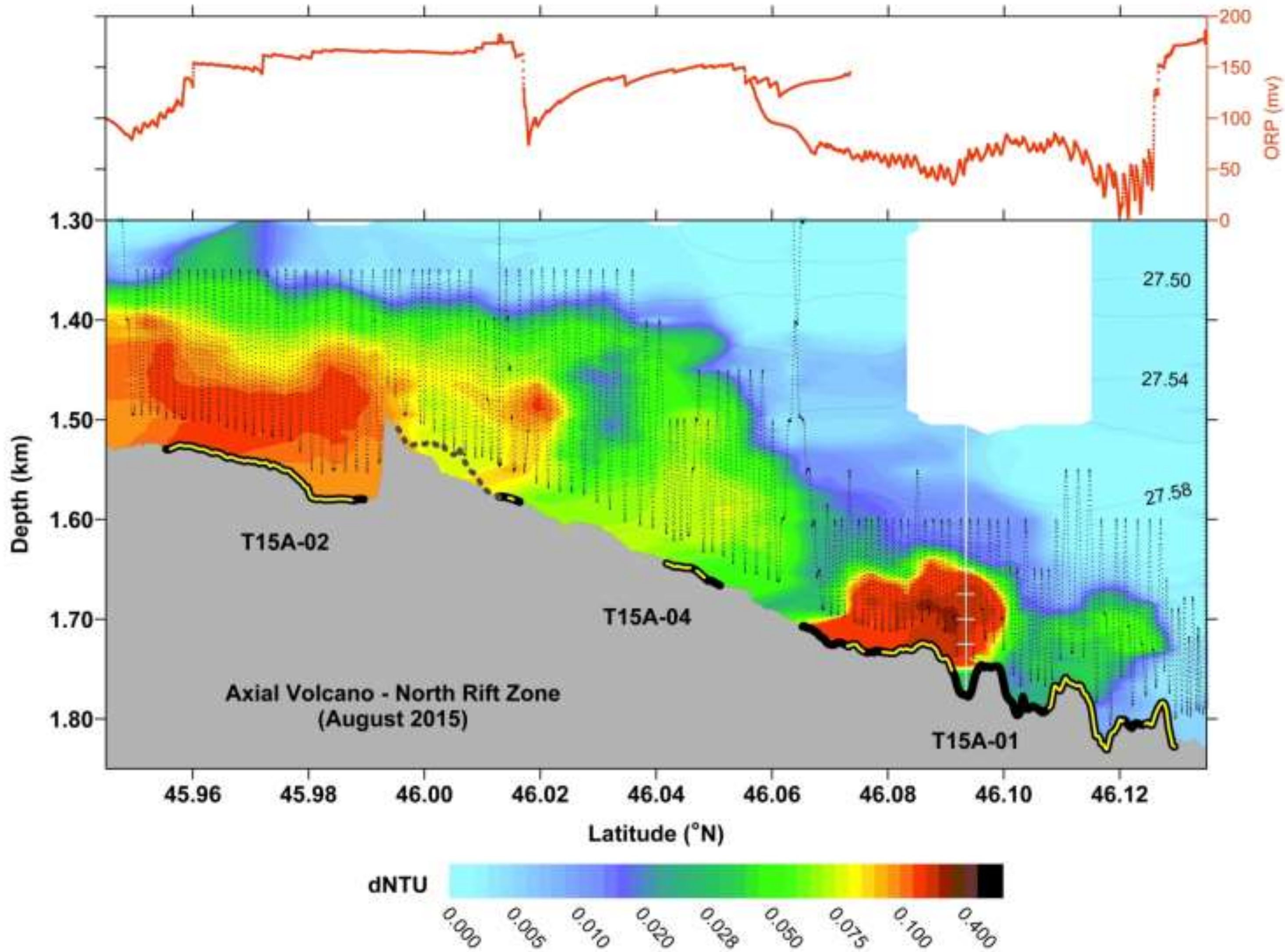


Figure 4.4-2 CTD survey (T15A-01, T15A-02 and T15A-04) of the Axial North Rift Zone and caldera. The top panel is an ORP profile where steep changes in slope indicate regions of reduced chemicals. The bottom panel is an LBS profile over bottom bathymetry where heavy black outlines indicate the extent of new lava flows. Lines of yellow superimposed with the heavy black lines indicate areas where CTD tows intersected new lava. Tow tracks as well as niskin depths are also included and contour values indicate density. Courtesy of S. Walker.

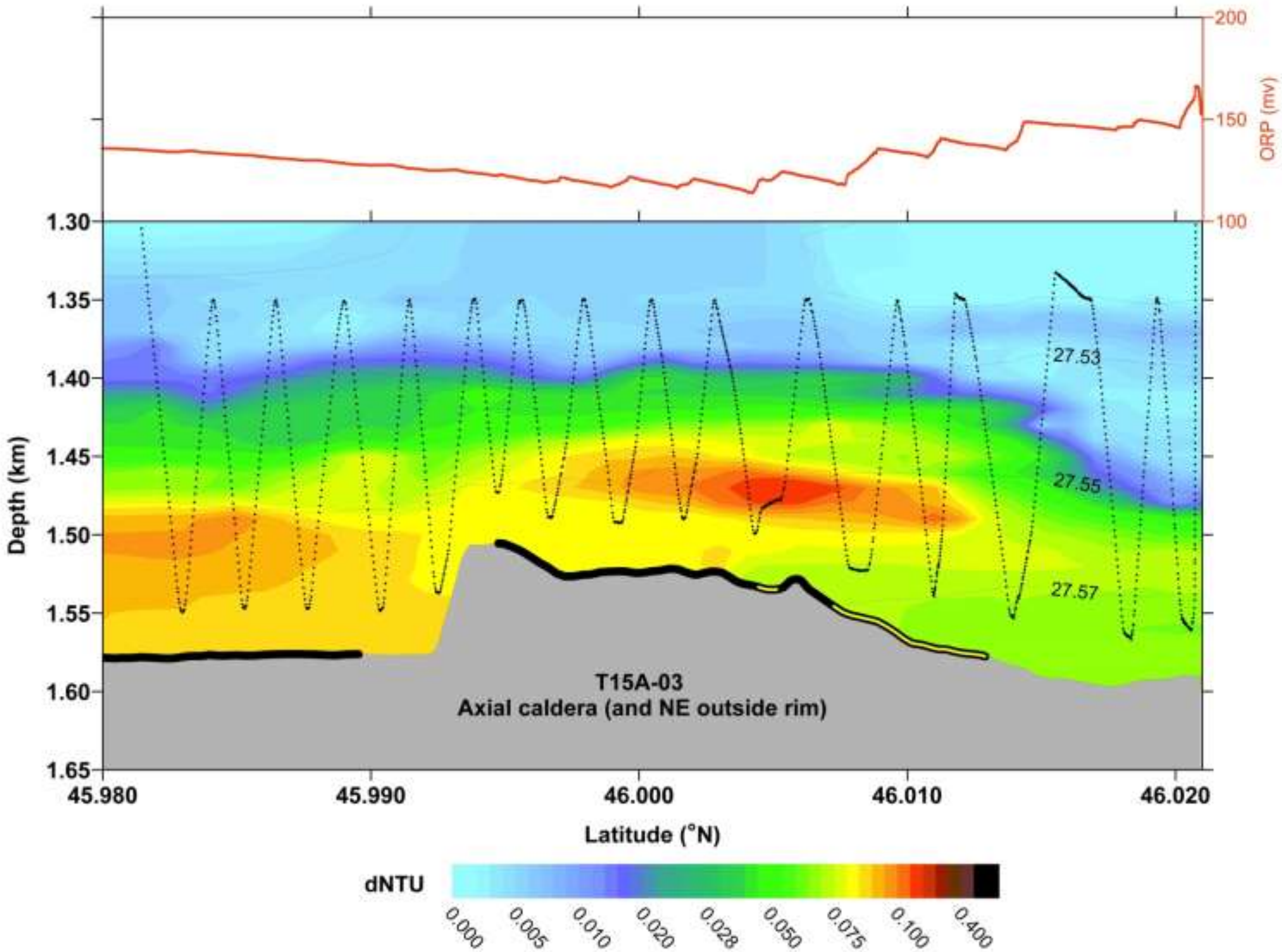


Figure 4.4-3 CTD survey T15A-03. The top panel is an ORP profile where steep changes in slope indicate masses of reduced water. The bottom panel is an LBS profile over bottom bathymetry where heavy black outlines indicate the extent of new lava flows. Lines of yellow found superimposed with the heavy black lines indicate areas where CTD tows intersected new lava. Tow tracks as well as niskin depths are also included and contour values indicate potential density (σt) . Courtesy of S. Walker.

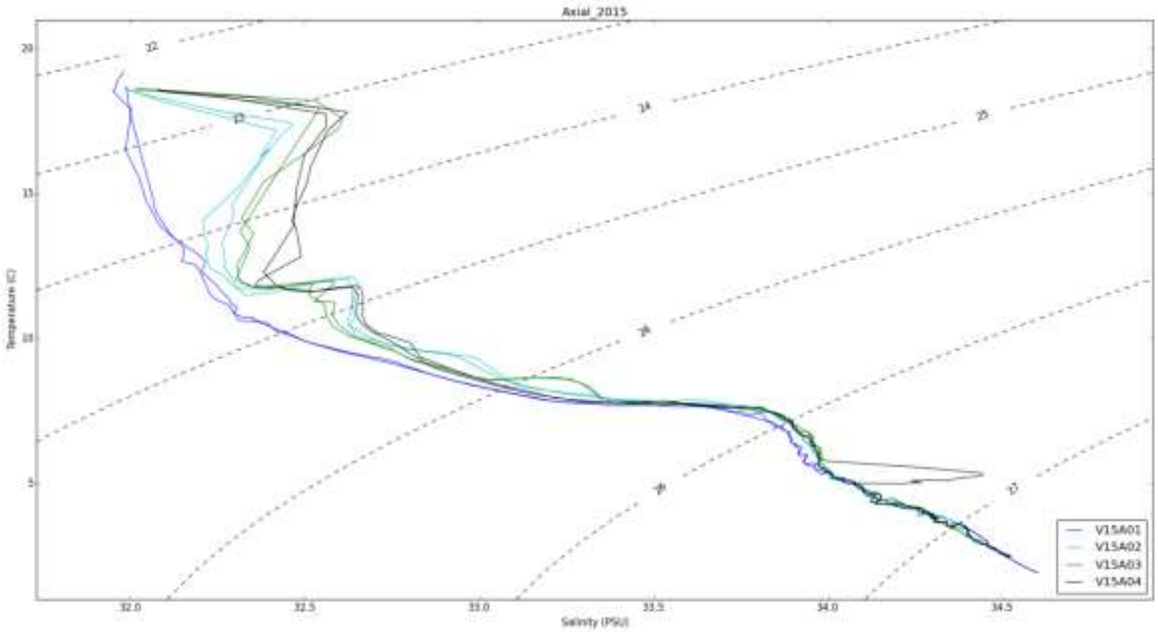


Figure 4.4-4 T-S diagram of vertical casts V15A01 (Background), V15A02 (Vixen), V15A03 (Ashes), V15A04 (International District Vent Field). Contours indicate potential density (σt)

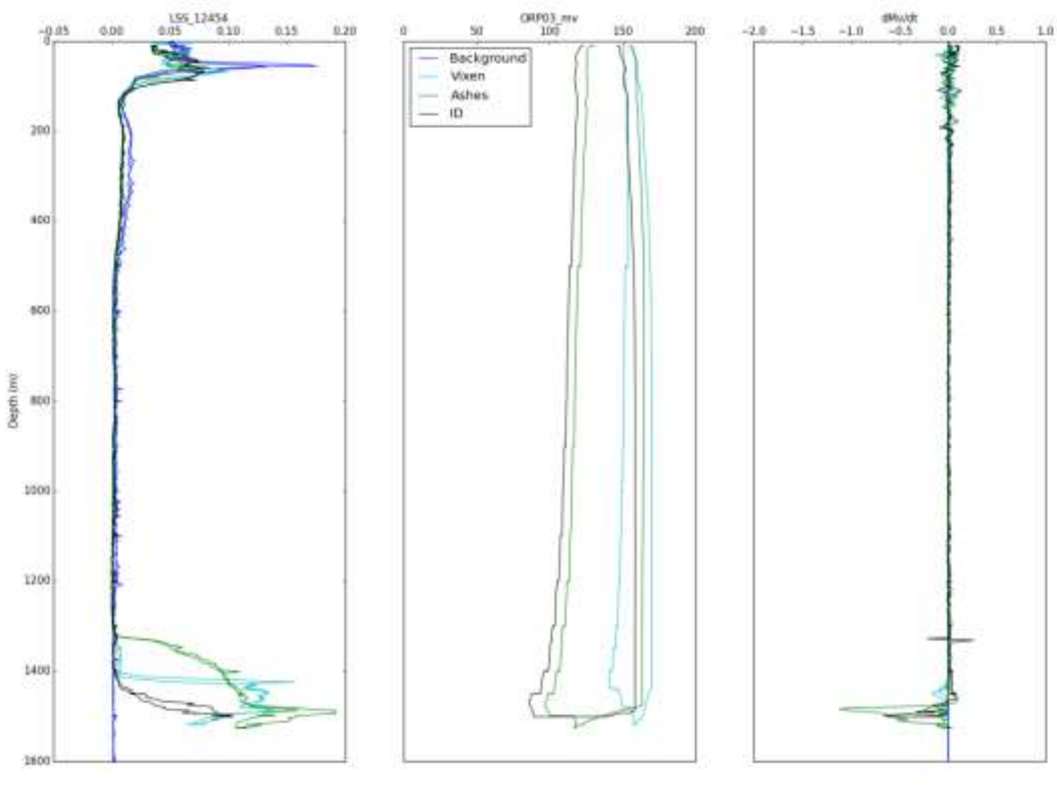


Figure 4.4-5 LSS, ORP, and the time differential of ORP (dmV/dt) plotted with depth for vertical casts V15A01 (Background), V15A02 (Vixen), V15A03 (Ashes), V15A04 (International District Vent Field).

4.5 Moorings

Matt Fowler, Oregon State University

Mooring Operations:

Objectives:

- Recover Ocean Bottom Hydrophone (OBH)
- Recover 3 Bottom Pressure Recorders (BPR)
- Deploy new OBH instrument and platform
- Recover OBH data
- Recover data and re-battery BPRs
- Deploy 3 BPRs
- Deploy MAPR mooring with 5 MAPRs at plume depths
- Deploy RAS mooring

Recoveries:

We recovered the OBH and 2 BPRs during daylight hours on 8/18/15; 1 BPR was recovered on 8/26/15.

The OBH recovery was at 15:37 UTC in rough seas and resulted in the instrument being slammed into the side of the ship before enough tag lines were attached to control the swing. After sufficient tag lines were attached the instrument was successfully recovered. The impact with the ship irreparably damaged the external hydrophone element, and seriously damaged OBH platform. The OBH housing has minor corrosive pitting. The end caps are in generally good condition.

BPR South-1, and BPR South-2 were both recovered without incident at 16:35 and 17:36 UTC. BPR center was left in place for the duration of the pressure dive for calibration purposes, then recovered at 00:46 on 8/26/15

Instrument Turnaround:

Data:

The OBH logged data to 80 GB hard drives for the duration of the 2 year deployment with no resets, and clock drift of 1.3 seconds.

All 3 BPRs logged data for their entire 2 year deployment with no clock errors or system malfunctions.

Instrument Preparation:

The OBH was initialized for deployment with no issues.

BPR South-1 failed to initialize after the battery was changed. The initialization went well, the instrument was responsive while setting the time and date, it formatted the compact flash card used as the storage medium, and executed the “log” command prior to deployment. After the first 7 samples, taken at 15 second intervals, the instrument “froze” 1 minute 45 seconds into logging. Repeated attempts to reset instrument by cycling power, disconnecting and reconnecting the serial cable, and pressing “reset” button had no effect. This instrument will be sent to PMEL Seattle for repair.

BPR South-2 and BPR Center initialized normally for deployment.

No initialization was required for the MAPRs prior to their deployment; all had been set-up in Seattle prior to departure by Sharon Walker.

Deployments:

All deployments were daylight operations. All went as scheduled.

Instrument: OBH

Deployment date and time: 8/20/15 01:05 UTC

Location: 46 05.7652N 129 58.8176W 1766m Workboat surveyed

Release Information:

Serial Number: 33686

Tx and Rx Frequencies: 11.0KHz and 12.0KHz

Enable code: 372432

Disable code: 372457

Release code: 354266

Comments: No mounting hardware was sent with OBH platform. Mounting hardware from recovered OBH didn’t fit new platform. The recovered platform was too badly damaged during recovery to reuse. OBH was fitted onto new platform without supporting plastic blocks to isolate the instrument from the platform. Heavy gauge rubber pads were fabricated to provide necessary isolation, however, this system is probably **not as robust as with correct mounting points**. While potential corrosion issue has been minimized, it is **HIGHLY recommended this instrument be recovered in calm conditions, and that it is NOT the first recovery of subsequent cruise**. This is to allow deckforce training with a BPR or similar mooring prior to OBH recovery. **High possibility of losing instrument from the platform if allowed to slam into ship during recovery.**

Instrument: BPR Center

Deployment date and time: 12:40 8/27/15 UTC

Location: 45 57.407N 130 00.636W 1541m depth

Release Information

Serial Number: 46806

Tx and Rx Frequencies: 11.0KHz and 12.0KHz

Enable code: 520475

Disable code: 520504

Release code: 534071

Comments: Anchor plates were incorrectly fabricated. Metal cups on anchor plate were at 18” on center spacing while the BPR platform legs were 20” on center. Only 2 legs were fitted into leg cups and platform was positioned off center of the anchor plate. Otherwise standard deployment. Important to have replacement stainless steel hose clamps to secure the end caps during BPR turn-arounds, and particularly important to ensure that the worm screw on the hose clamps is also stainless steel, as sometimes the clamp is stainless, but not the screw, and these corrode during a deployment.

Figure 4.5.1 BPR anchor plate.

Instrument: BPR South-2

Deployment date and time: 21:55 8/19/15 UTC

Location: 45 54.956N 129 59.609W 1538m depth

Release Information

Serial Number: 32673

Tx and Rx Frequencies: 11.0KHz and 12.0KHz

Enable code: 667237

Disable code: 667252

Release code: 650364

Comments: Anchor plates were incorrectly fabricated. Metal cups on anchor plate were at 18” on center spacing while the BPR platform legs were 20” on center. Only 2 legs were fitted into leg cups and platform was positioned off center of the anchor plate. Otherwise standard deployment. Important to have replacement stainless steel hose clamps to secure the end caps during BPR turn-arounds, and particularly important to ensure that the worm screw on the hose clamps is also stainless steel, as sometimes the clamp is stainless, but not the screw, and these corrode during a deployment.

Instrument: MAPR mooring

Deployment date and time: 16:55 8/27/15 UTC

Location: 46 05.607N 129 58.889W 1780m depth

Release Information

Serial Number: 34472

Tx and Rx Frequencies: 11.0KHz and 12.0KHz

Enable code: 272432

Disable code: 272457

Release code: 253141

Comments: No capstan was available for deployment. To avoid excessive uncontrollable tension developing while mounting 5 MAPRs at 25m intervals, while streaming the mooring out, the 250m jacketed wire was attached to float package secured to the deck and lowered over the side. After the top 150m was hung off the side of the ship, the MAPRs were mounted at 30m, 55m, 80m, 105m and 130m above the anchor. The target depth for the anchor was 1780m. After all MAPRs were mounted on the 250m jacketed wire hanging over side of ship, the bottom of the jacketed wire was attached to the anchor. The float package was deployed using the ship's crane and NOAA quick release. The ship repositioned 60m to be over target drop point, and stretch out the float/250m jacketed wire prior to deployment of the anchor using ship's crane and NOAA quick release. Calm seas permitted a very safe, smooth, controlled deployment without a capstan.

Instrument: RAS mooring

Deployment date and time: 16:50 8/27/15 UTC

Location: 46 04.488N 129 59.712W 1717m depth

Release Information: NONE – ROV Pull Pin release

Comments: Jason dropped descent weight and moved RAS into position at hydrothermal vent and placed intake tube into vent.

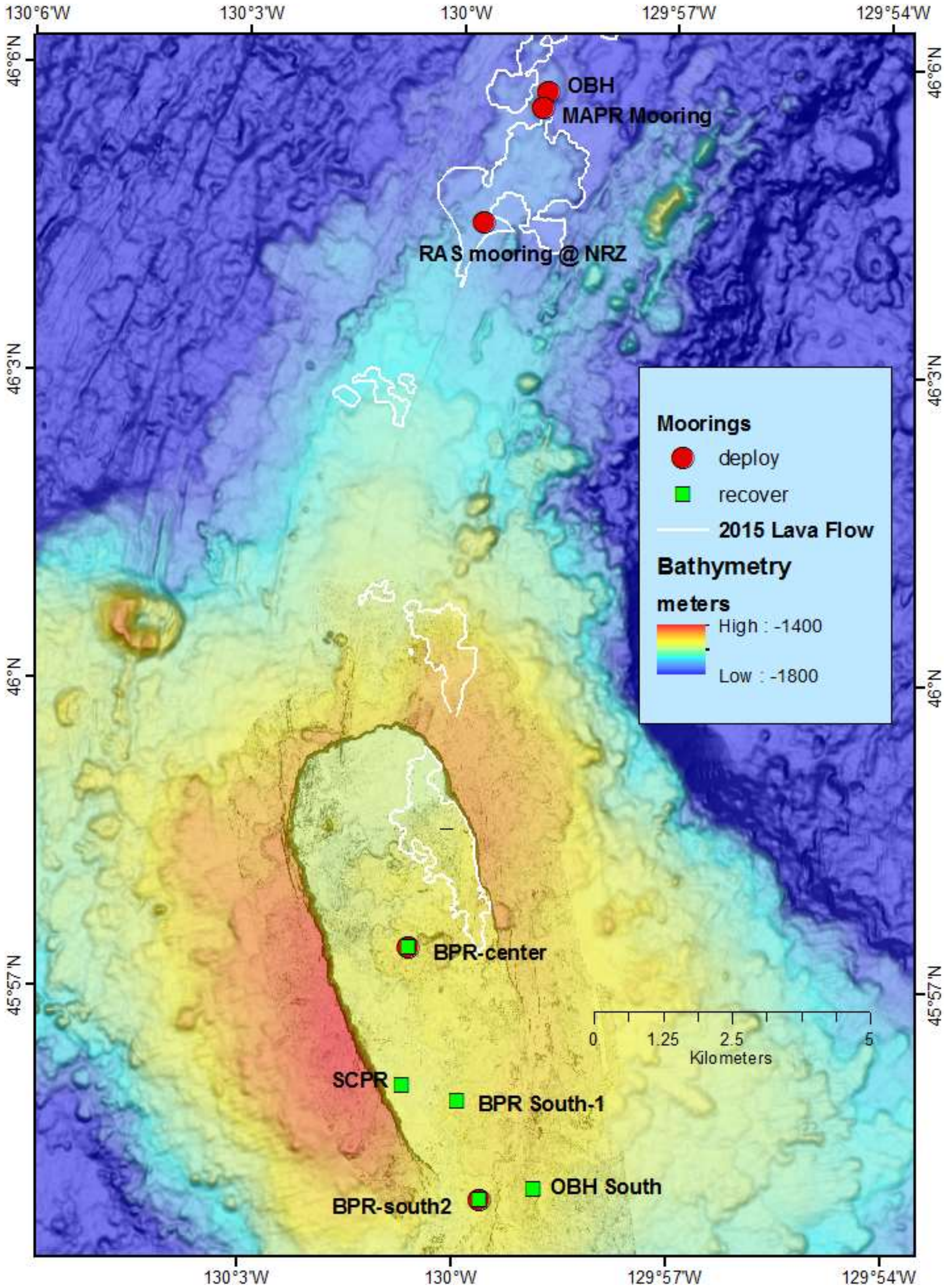
Table 4.5-1 Mooring Recoveries

Instrument	Deployed	Recovered (UTC)	Depth	Latitude	Longitude
Surveyed positions unless otherwise indicated.					
BPR Center	5-Sep-13	26-Aug-15	1541	45.95678	-130.01060
BPR South-1	5-Sep-13	18-Aug-15	1540	45.93181	-129.99876
BPR South-2	5-Sep-13	18-Aug-15	1540	45.91599	-129.99348
OBH South	9-Sep-13	18-Aug-15	1539	45.91769	-129.98085
SCPR	7-Sep-13	18-Aug-15	1541	45.93438	-130.01178

Table 4.5-2 Mooring Deployments

Instrument	Deployed (UTC)	Depth	Latitude	Longitude	Notes
Surveyed positions unless otherwise indicated.					
OBH	8/20/15 1:05	1766	46.09609	-129.98029	There was no OBH-S in 2011
BPR-center	8/27/15 12:40	1541	45.95678	-130.01060	~200 m NNW of AX-101
BPR-south2	8/19/15 21:55	1538	45.91593	-129.99348	~160 m SSW of Vixen, ~320 m W of AX-304
RAS: final position and depth after ROV placement					
RAS mooring @ NRZ	8/27/15 16:50	1716	46.07470	-129.99505	NRZ with Mkr-294
MAPR Mooring	8/27/15 16:55	1780	46.09345	-129.98148	NRZ

Figure 4.5-1 Moorings Deployed and Recovered



4.6 Mapping

4.6.1 AUV Sentry Mapping

Jenny Paduan and Bill Chadwick

Goals
There were four goals of the AUV *Sentry* dives during this cruise: (1) Repeat the bathymetry tracklines across the caldera collected by the MBARI mapping AUV in 2014 to document depth changes due to volcanic deformation and tie the AUV bathymetry to the seafloor pressure measurements being conducted this year, (2) expand the AUV bathymetric mapping coverage beyond the caldera to serve as a baseline for repeat mapping for deformation monitoring in future years, (3) collect high-resolution bathymetry over as many of the 2015 lava flows as possible, and (4) simultaneously collect water column MAPR data over the 2015 lava flows to augment the CTD plume mapping. The MAPR data collection was successful, but will require on-shore data analysis, so is not discussed further here.

Methods
The AUV *Sentry* multibeam sonar mapping dives were conducted such that: (1) the survey altitude was 65 meters, (2) the survey speed was ~1.8 knots, (3) the line spacing of the survey tracklines was 160 meters. This yielded a lateral resolution of about 1.5 meters. Dive durations were generally 24 hours or less.

The AUV *Sentry* was made six dives during this cruise (dives 336-341). Four of those missions successfully recorded multibeam sonar data (338-341). During the first two dives (336 and 337) a newly installed Reson sonar receive head was found to have the wrong firmware installed by the vendor, which caused the multibeam sonar data that it collected to be unusable. The surveys were designed by Expedition Leader Dana Yoerger after consultation with Bill Chadwick (Chief Scientist), and David Clague and David Caress (MBARI). Vehicle configurations, sensor performance, vehicle statistics, and post-dive summaries are detailed in the operations report “Sentry Operations Report for the Chadwick/NEMO 2015 Cruise.”

The multibeam mapping sonar on the vehicle is a Reson 7125 400 kHz multibeam sonar. Sidescan sonar data were also collected during the dives and a MAPR instrument supplied by NOAA/PMEL was also integrated into the *Sentry* logging system. USBL updates were given periodically throughout each mission when the AUV was with range of the ship and these incorporated into the AUV navigation in post-processing. LBL tracking was used to monitor the vehicle's progress but not used in the navigation processing.

The software package MB-System was used for additional post processing of the bathymetry data, including incorporating the vehicle navigation and attitude sensor data with the sonar data, applying a roll bias of -0.6 degrees, a timelag constant of 0.125 sec, tide correction with the OSU Tidal Prediction Software (OTPS) model, and ping editing. Tide correction using OOI BPR data has yet to be done. The vertical offset between the Paroscientific depth sensor and the multibeam on the vehicle has not been corrected. Navigation adjustment to accommodate for lateral drift of the vehicle was done with the MB-System program mbnavadjust separately for each survey, using fully edited, OTPS tide and roll-bias corrected data. However, the surveys have not yet been tied to any EM302 or ROV fixes, nor to each other, and therefore the data for each survey are floating in X, Y, and Z relative to only that survey. With those caveats, maps of differences between these surveys and previous bathymetry data are still preliminary.

Summary of Dives 336 and 337
Sentry dive 336 was the longest during the cruise (28.5 hours) and was meant to collect multibeam bathymetry (and MAPR water column data) over the two largest of the 2015 lava flows on Axial’s North Rift Zone. The multibeam sonar did not work properly during this dive, but MAPR data were successfully collected.

Sentry336 launch position: 46 4.531’N 129 58.248’W
8/16 1722 UTC: Sentry in water
8/17 2201 UTC: Sentry on deck

Sentry dive 337 was a short (~7 hours) test dive south of the ASHES vent site to test whether the attempted fixes of the multibeam sonar had been successful (they had not) and to flying it up and down the caldera wall to test the new bottom following software in Sentry that would be needed during the later deformation surveys (this was successful)

Sentry337 launch position: 45 56.242’N 130 0.813’W
8/20 1121 UTC: Sentry in water

8/20 1833 UTC: Sentry on deck

Mapping the 2015 lava flows

Mapping of portions of the 2015 flows was conducted with the AUV *Sentry* on surveys 338 and 341. Mapping of the flows deeper on the North Rift Zone was attempted on the failed survey 336, but there was not time to repeat that survey during this cruise.

Survey 338 covered the NE caldera floor where differencing between TN326 and MBARI Mapping AUV data indicated there was a new flow. The survey was co-located with the latter part of ROV *Jason* dive J2-822, which was in the water concurrently. It began in the SE corner, drove crossing lines, "mowed the lawn" over the area from the caldera wall at the east to beyond the southern, northern, western edges of the 2015 flow, and finished in the NW. Altitude for the entire survey was 65 m for 1.5 meter resolution data. The flow contacts observed on the *Jason* dive correspond well with the mapped differences in bathymetry data collected before and after the 2015 eruption (Fig.4.6.1-1 and see Fig. 4.1.2-4).

Sentry338 launch position: 45 58.569'N 129 59.994'W
8/21 1558 UTC: Sentry in water
8/22 0338 UTC: Sentry on deck

Survey 341 started near the center of the caldera (where the ship and ROV *Jason* were at the time), climbed the east wall of the caldera and flew northward just E of the rim on the flank. It then "mowed the lawn" on the Upper North Rift Zone over the small patches of the 2015 flow detected in difference mapping between TN326 and MBARI AUV data, and on the north caldera rim, where a CTD tow this cruise indicated a plume. The survey was co-located with ROV *Jason* dive J2-825, which was in the water concurrently. Altitude flown was 65 m for 1.5 meter resolution data.

Sentry341 launch position: 45 57.694'N 130 0.515'W
8/26 2349 UTC: Sentry in water
8/27 1450 UTC: Sentry on deck

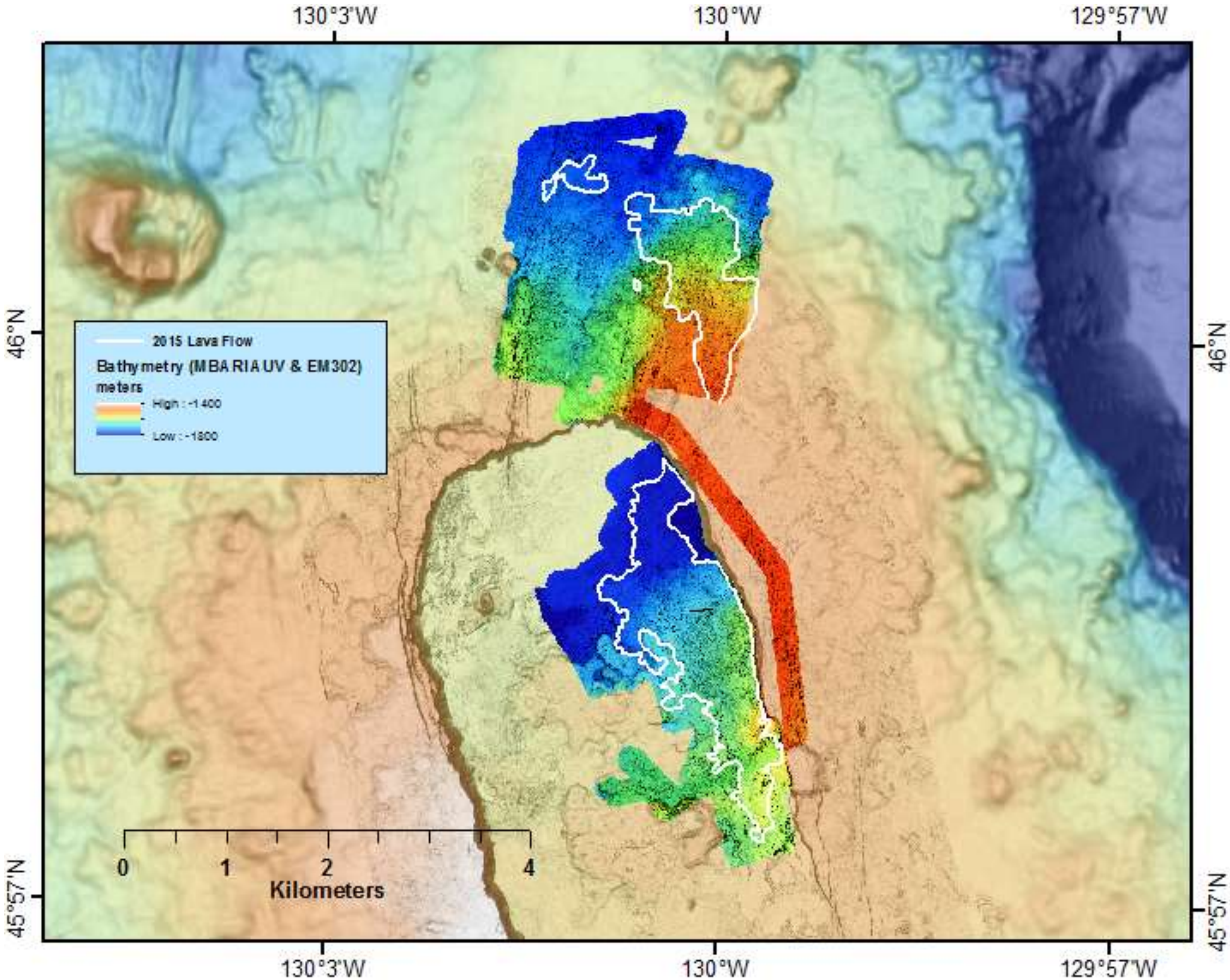


Fig. 4.6.1-1 AUV Sentry mapping surveys 338 and 341 overlaid on bathymetry data previously collected with MBARI AUV and R/V Thompson. Sentry 338 survey was focused on the NRZ lava flows, north of the caldera rim. Sentry 341 survey began inside the caldera and the eastern portion of the NRZ new lava flow.

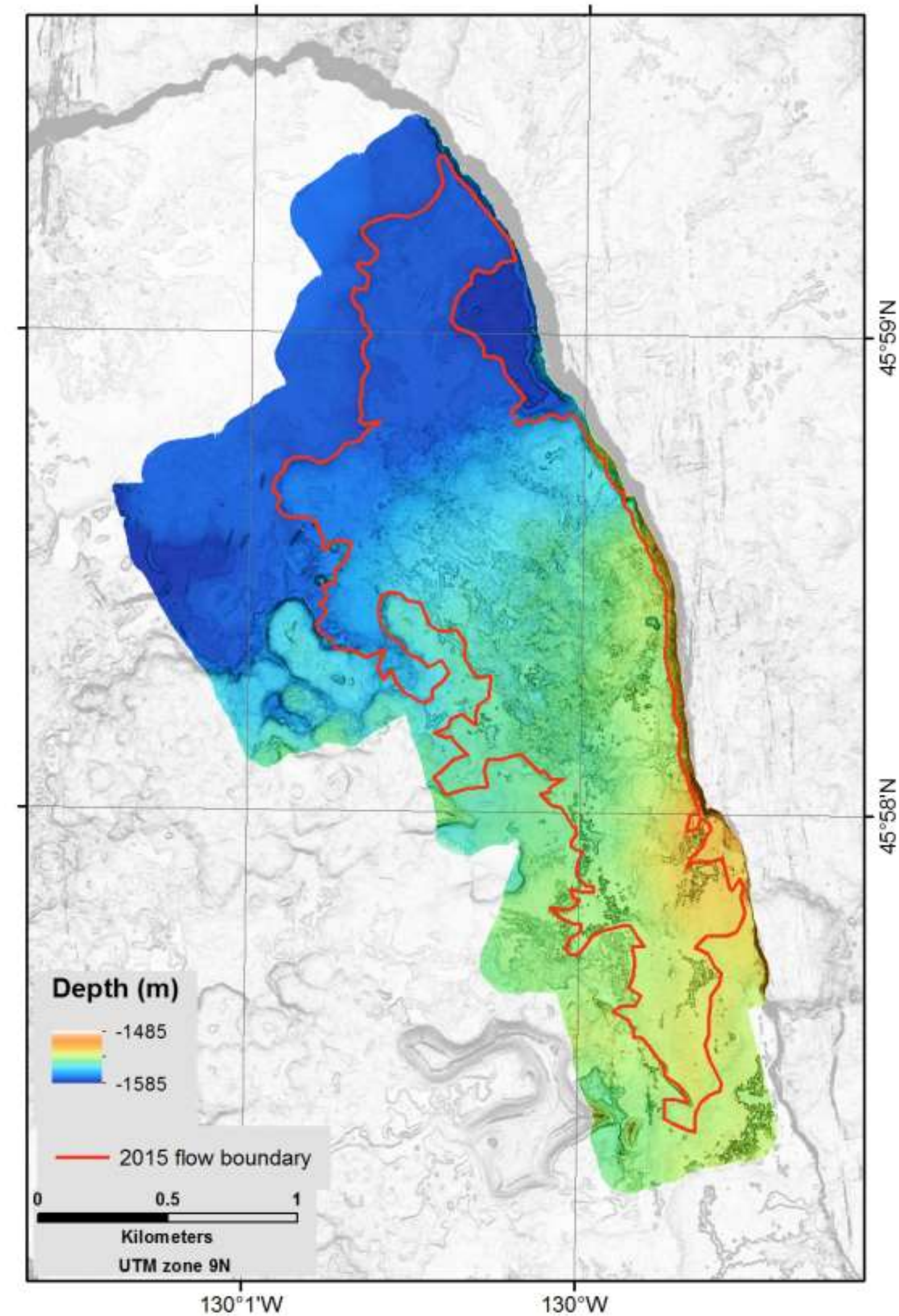


Fig. 4.6.1-2 Colored bathymetric grid of Sentry Dive 338 in Axial's caldera. Red outlines of the 2015 lava flows and superimposed on a slope map of regional bathymetry.

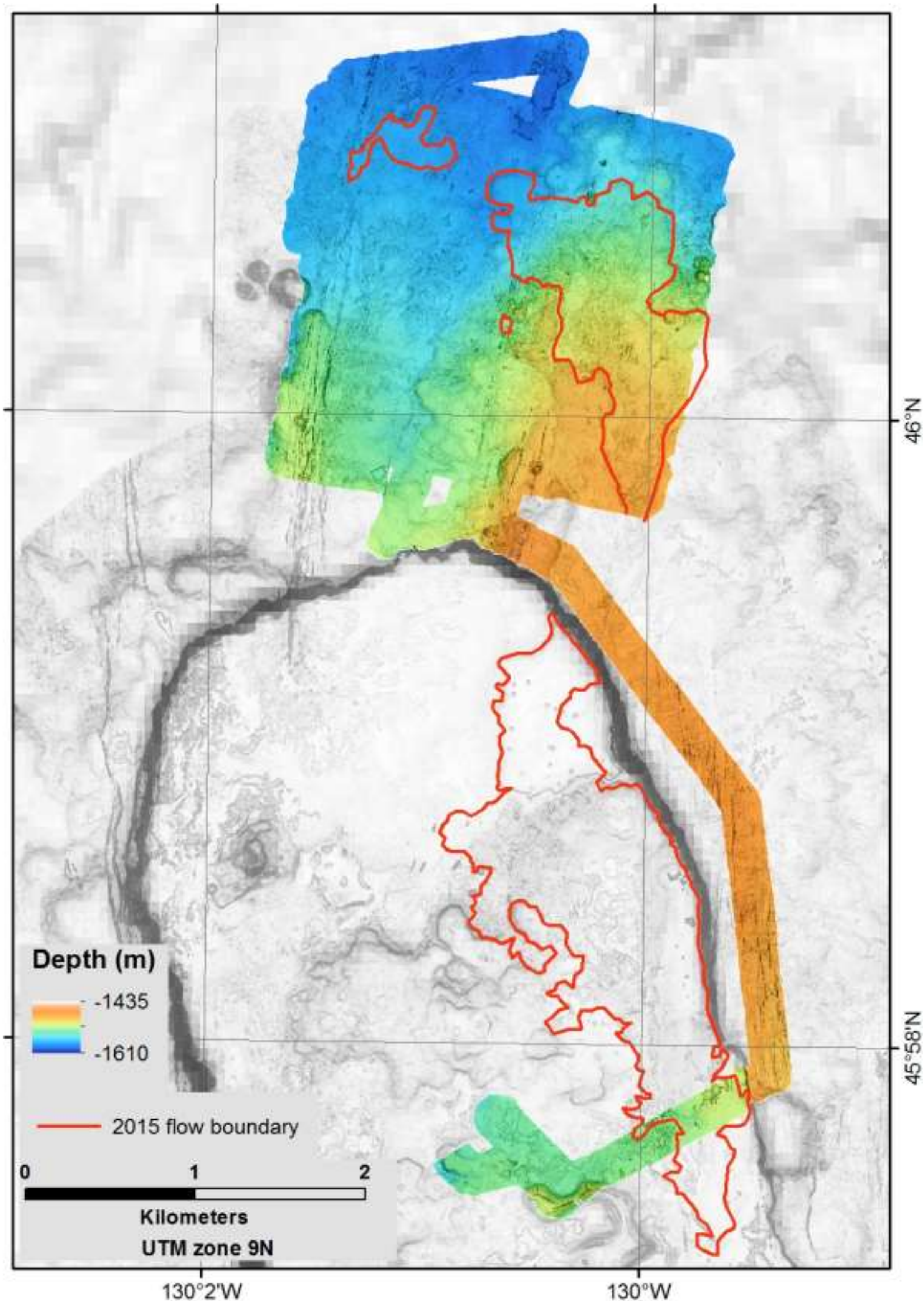


Fig. 4.6.1-3 Colored bathymetric grid of Sentry Dive 341 in Axial caldera and the eastern portion of the North Rift Zone. Red outlines of the 2015 lava flows and superimposed on a slope map of regional bathymetry.

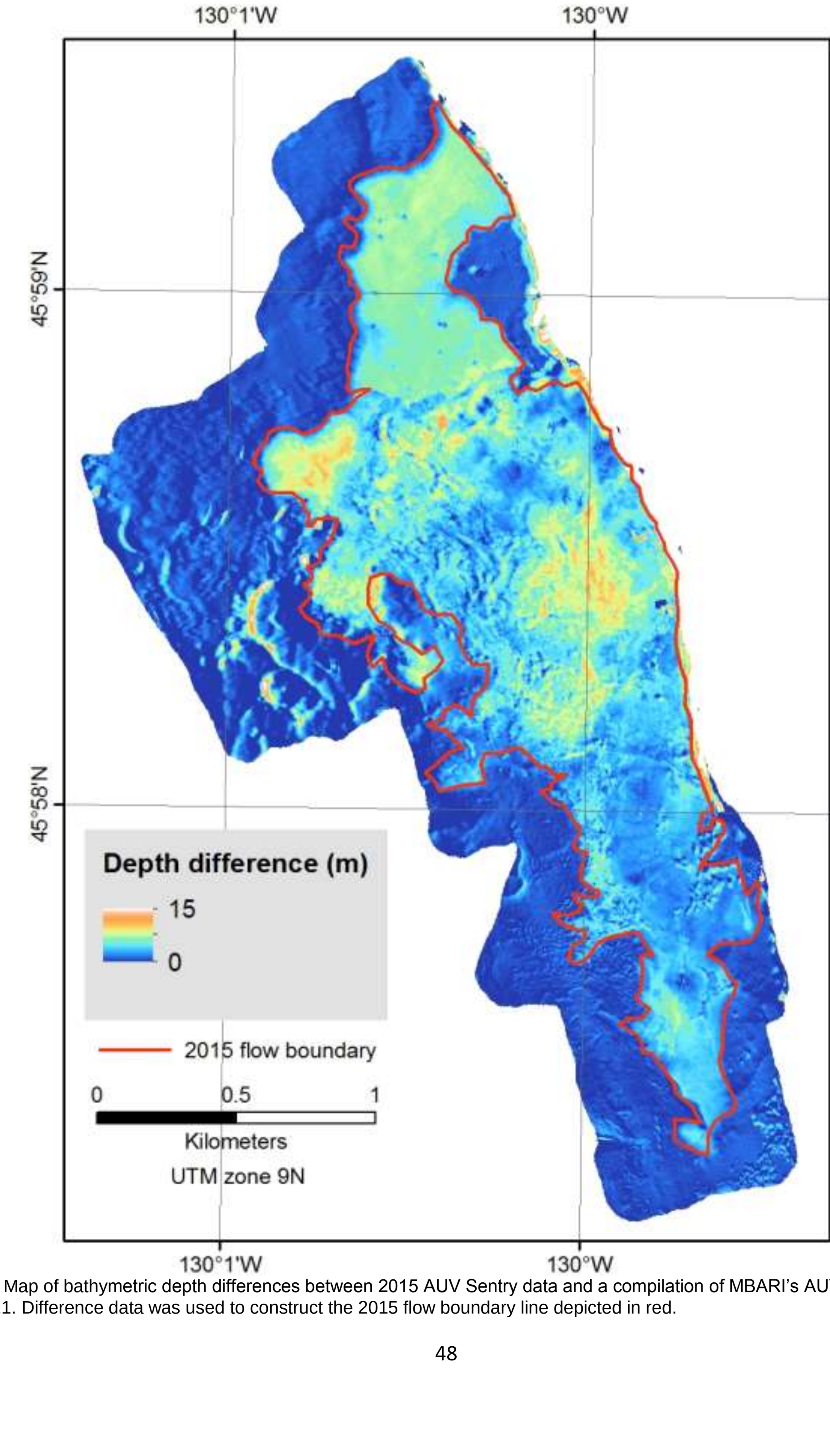


Fig. 4.6.1-4 Map of bathymetric depth differences between 2015 AUV Sentry data and a compilation of MBARI's AUV data collected through 2011. Difference data was used to construct the 2015 flow boundary line depicted in red.

Deformation study

Two multibeam sonar surveys by AUV *Sentry* ran patterns across the caldera designed for extracting vertical deformation of the volcano. These surveys continue a time series begun with the MBARI Mapping AUV and complement the time series of pressure measurements at seafloor benchmarks and with BPRs on the seafloor. The inflation detected with a survey by the MBARI Mapping AUV in the summer of 2014 (described in the MBARI 2014 Annual Report: http://www.mbari.org/news/publications/ar/2014ann_rpt.pdf), compared with a post-2011 eruption survey in 2011, showed a net uplift of 1.8 m at the center of the caldera over the 3-year period. This was consistent with rate of inflation observed in 2013 by the pressure measurement of ~ 60 cm/yr. This information was important in the successful forecast of the April 2015 eruption.

Survey 339 (Fig. 4.6.1-2) repeated a pattern over the caldera floor that the MBARI Mapping AUV ran in 2014 and 2011, and also flew over the pressure measurement benchmarks that ROV *Jason* was visiting during the concurrent dives J2-823 and J2-824, to directly compare with those measurements. Altitude for deformation part of the survey was 65 m for 1.5 meter lateral resolution. At the end of the survey a test pattern was run (while waiting for the ship to get into range for rendezvous), in which the *Sentry* flew at 65 m altitude, and then at 110 m and higher altitudes with narrower beam angles so coverage should be the same, to test whether outer beam-forming artifacts could be reduced.

Sentry339 launch position: 45 55.568'N 129 58.605'W
8/23 0006 UTC: Sentry in water
8/24 0019 UTC: Sentry on deck

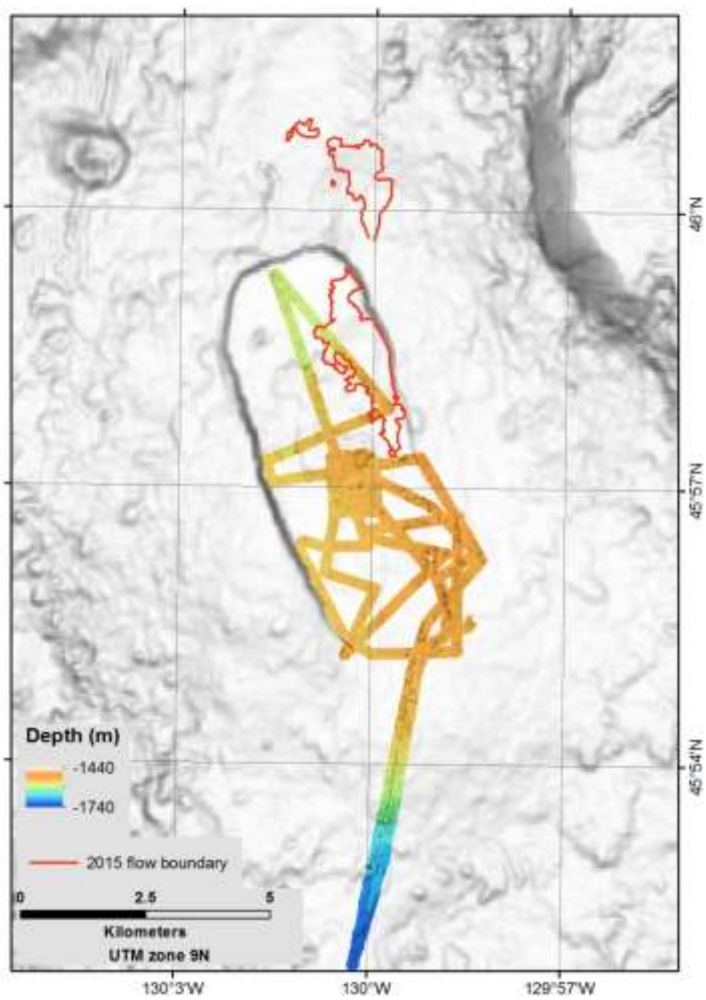


Fig. 4.6.1-2 Map of bathymetry data from AUV Sentry survey 339, superimposed on a slope map of regional bathymetry. Boundaries of lava flows erupted in 2015 are shown (red lines) for reference. Map shown at the same scale as 4.6.1-3.

Survey 340 (Fig. 4.6.1-3) was designed to establish a new pattern for future repeat mapping, which increases the lateral extent of the deformation measurements to enable a more three-dimensional analysis of the dynamics of the volcano. The new pattern is a large 3-triangle array that includes the flanks as well as the caldera, with crossings over the center of the caldera. The altitude for the survey was 65 m for 1.5 meter lateral resolution data.

Sentry340 launch position: 45 55.834'N 130 1.214'W
8/24 2106 UTC: Sentry in water
8/25 2029 UTC: Sentry on deck

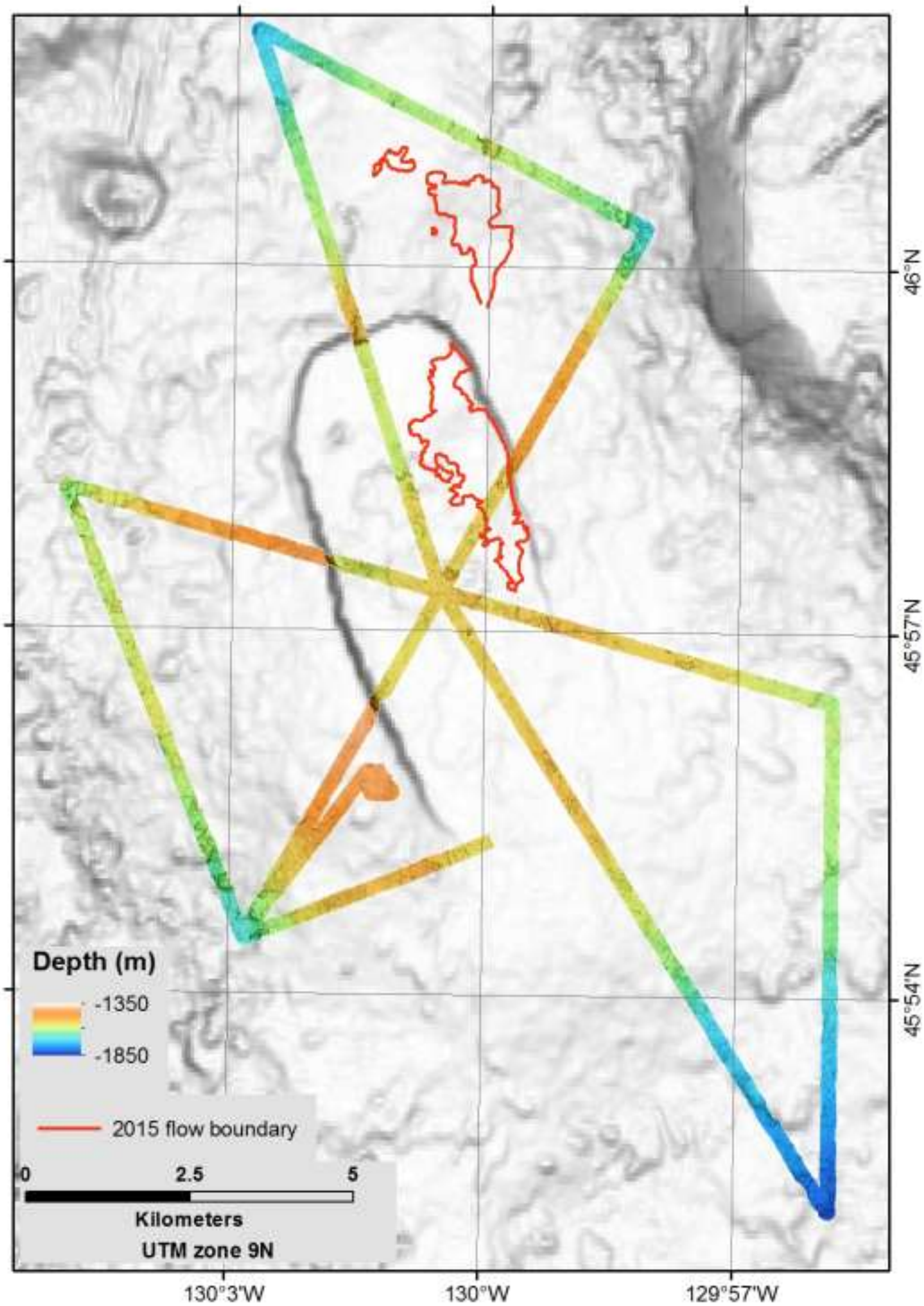


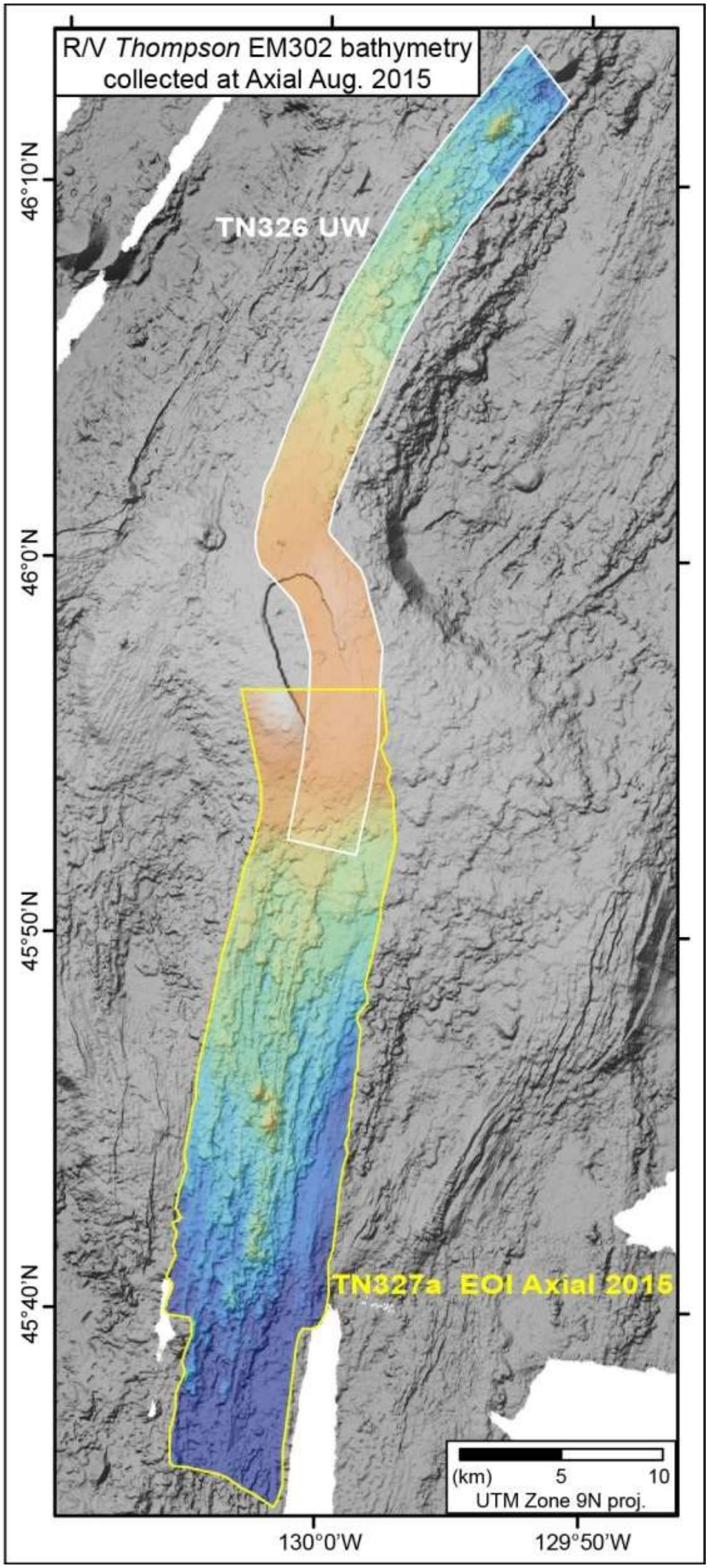
Fig. 4.6.1-3 Map of bathymetry data from AUV Sentry survey 340, superimposed on a slope map of regional bathymetry. Boundaries of lava flows erupted in 2015 are shown (red lines) for reference. Map shown at the same scale as 4.6.1-2.

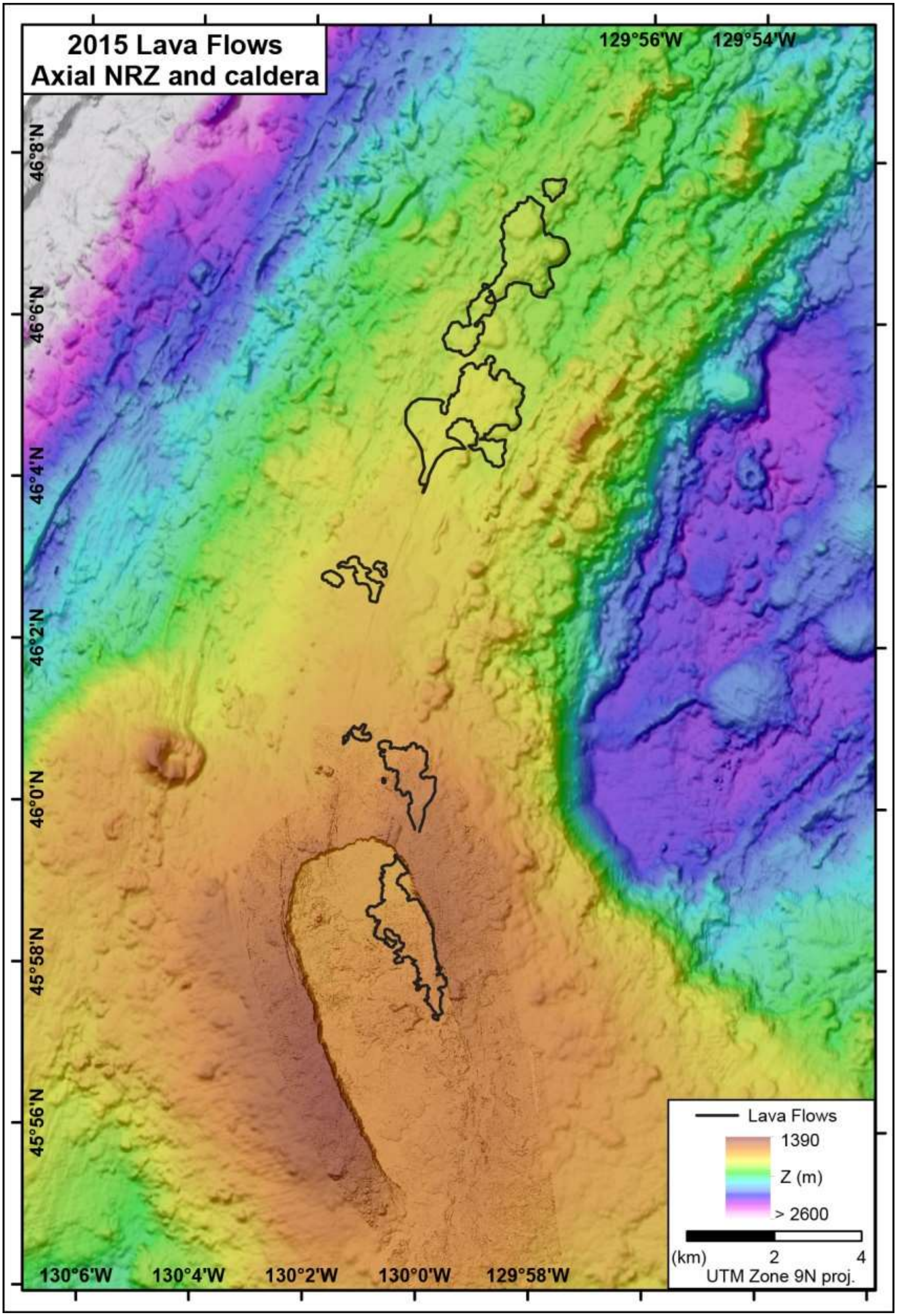
4.6.2 EM302 Multibeam Mapping

Susan G. Merle, OSU

The focus of multibeam mapping during the TN327a (Axial 2015) expedition on the R/V *Thompson* was to re-survey the south rift zone (SRZ) at Axial to determine whether or not the 2015 eruption produced lava flows south of the caldera. The north rift zone (NRZ) had been mapped on the previous University of Washington expedition, TN326 (2015). Deb Kelly was expedition leader for TN326 and Brendan Philip processed those data. Surface differencing was performed on the NRZ data, comparing bathymetry collected on TN326 and TN300 (2013), revealing numerous large lava flows extending to 15 kilometers north of the caldera rim. There were no significant surface differences in the data on the SRZ when comparing data from TN327a and an earlier bathymetry compilation. Those results indicate that there was no lava extruded south of the caldera during the 2015 eruption. During the expedition Jenny Paduan discovered thinner flows in the caldera and north of the caldera rim when surface differencing was performed between the data collected on TN326 and the MBARI AUV data (see section 4.6.1).

276 km^2 were mapped on the SRZ during TN327a. Additional data were collected during the transit and while working in the caldera area. Those data are not included in the calculation, or the final data that will be submitted to NGDC (now NCEI), as they were not planned surveys and ship speed was usually above optimal survey speed.


R/V Thompson EM302 bathymetry
collected at Axial Aug. 2015
TN326 UW
TN327a EOI Axial 2015
46°10'N
46°0'N
45°50'N
45°40'N
130°0'W
129°50'W
(km) 5 10
UTM Zone 9N proj.



2015 Lava Flows
Axial NRZ and caldera
129°56'W
129°54'W
46°8'N
46°6'N
46°4'N
46°2'N
46°0'N
45°58'N
45°56'N
130°6'W
130°4'W
130°2'W
130°0'W
129°58'W
Lava Flows
1390
Z (m)
> 2600
(km) 2 4
UTM Zone 9N proj.

4.7 Outreach and Education

Rachel Teasdale, California State University - Chico

Outreach and Education Activities Rachel Teasdale, California State University - Chico

Ship-to-shore Skype calls to classrooms:
Ten ship-to-shore Skype calls were completed from R/V Thompson to K-12 and university classrooms school classrooms in Oregon and California (the home states of PI Chadwick and outreach coordinator Teasdale, respectively). Skype calls were to High School science classes (3); Junior High School classrooms (3) and to the visitor center auditorium at the Hatfield Marine Science Center (HMSC) in Newport Oregon, and to two summer camps in Newport Oregon*.* In several cases, teachers hosted the Skype calls in auditoriums to have 3 or more classes attend the interaction with scientists on board the research cruise. As such, we estimate that with approximately 30 students per single class plus the combined classes, there were approximately 323 students participating in the calls plus an addition 35 members of the public at the HMSC visitor center. The Axial 2015 blog (axial2015.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 Research Scientists and Co-PI's Dave Butterfield (UW), Bill Chadwick (OSU-NOAA) and Jim Holden (UMass) talk with approximately 90 school children in rural Marysville, California from R/V Thompson during the 2015 Axial Seamount expedition.

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

Examples of letters from school children are included at the end of the Outreach summary.

Educational Cruise Blog:
http://axial2015.blogspot.com

Blog entries were posted at least daily, from just prior to the cruise through the final entry posted the day we arrived in port, making a total of 24 blog entries created and posted. Blogs describe the scientific teams and the research conducted onboard, with background information to help readers better understand the geologic setting and significance of Axial Seamount. Videos were embedded in 11 blogs to introduce scientists explaining their research, the instruments and experiments to do their work, as well as videos that help illustrate life on board the R/V Thompson. Videos also expand on blog entries to show how work with AUV *Sentry* progress to developing sea floor maps and how collecting samples with ROV *Jason* continues on board the ship and in preparation for further analyses in labs onshore. 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. Skype participants were encouraged to follow the blog before and after the Skype events. There were 7798 hits to the blog recorded, the most popular blog entries were "The Science Team," which was created from information submitted by 15 (of 19) science team members on the cruise, describing their professional backgrounds, preparation for their careers and their goals for the cruise. Other popular blogs were (in descending order) "Introduction" to the cruise, "2015 Eruption", "Pressure Dive", and "Facilitating Science." Most hits to the blog from the United States, Canada and Turkey (which corresponds to countries of origin for researchers on board) with additional hits from other countries in smaller numbers. The Axial 2015 cruise blog was mirrored on the OceanScape Network web site (http://oceanscape.aquarium.org/), an outreach and education site created by the Oregon Coast Aquarium.

Blog videos were created at sea by Jesse Crowell in association with Saskia Madlener and 77th Parallel Productions.

Table 4.7-1 Outreach Skype Participants

#	Date	Time	Teacher Contact	Grade/Group Info	Science Interest	School	Class info	# students
1	**Fri Aug 14**	**10-10:45**	Tracy Crews	Native American Kids Camp	Marine Science	Ocean/HMSC Newport, OR	Mid School	10
2	**Tues Aug 18**	**1-1:45 pm**	Tracy Crews	Girls Engineering/ Marine Camp	Marine Science	Ocean/HMSC, Newport OR	Mid School	18
3	**Weds Aug 19**	**8:00-9:00**	Dave Atkinson	HS (AP classes)	Geology, Biology, Physics	Lindhurst HS, Marysville CA	HS/2-3 classes	90
4	**Thurs Aug 20**	**2:05-2:40pm**	MaryAnne Pella Donnelly	Junior HS-Gate	GATE Life Sci	Chico Jr HS, CA	Jr HS/ 1 class	30
5	**Sat Aug 22**	**1:30-2:00**	Bill Hanshumaker	Public visitors		Hatfield Marine Science Center OR	General public	35
6	**Mon Aug 24**	**8:50-9:45**	Tom George	HS	Earth Sci	Pleasant Valley HS CA	HS/ 1 class	30
7	**Tues Aug 25**	**8:45-9:35**	Ray Barber	HS	Chem/Biol	Pleasant Valley HS CA	HS/ 1 class	30
8	**Weds Aug 26**	**9-9:50**	Rachel Teasdale	University	Mineralogy & Lithology + Dept Geological/ Environmental Science	CSU, Chico CA	Ugrad/ 1 class + open to dept	25
9	**Thurs Aug 27**	***8:30-9:30***	Casey Link	5, 6, 7	all Biol, Earth, Chem	Chrysalis Charter School, Redding CA	60	60
10	**Fri Aug 28**	**8:55-9:45**	Kelly Coombe	Junior HS		Marsh Jr HS, Chico CA	7th Grade/ 1 class	30
							Total Skype Participants	358

Examples of letters from school children:

Chico Junior High School

280 Memorial Way
Chico, CA 95926
(530) 891-3066
August 26, 2015

Dear Dr. Holden and Dr. Chadwick,

Thank you so much for taking the time to facilitate a web conference with my students. They were very impressed that "real" scientists took the time to speak to them, and to do so while out in the field. We really enjoyed the experience.

We look forward to additional opportunities and would love to speak via Skype again, from your lab or out in the field, if you have the time and willingness.

Again, thank you.

Respectfully,

Mary Anne Pella-Donnelly

Mary Anne Pella-Donnelly

Chico Junior High School

Dear Jim Holden,

Thank you so much for having a chat with our class! I learned so many things like there are 55 people on the ship and that you have engineers on the Ship. I also learned that ROV's that the ship uses are as big as a mini van! I thought they were only at least as big as a side table. It was actually intresting to find out that everytime an underwater volcano deflates or inflates it doesn't cause a tsunami. I also thought it was cool that interested crabs climbed on the eqquipment. A question that I have is that how long are the trips usaully out at sea?

Sincerly,
Sophia L.

Dear Dr. Chadwick and Dr. Holden,

Thank you for talking with us and answering all our questions! I learn a lot, including that there is an underwater volcano that is a "wired volcano", and that there are worms that have no mouth or stomach and get all their nutrients from chemicals that come from Axial Seamount. I also learned that there are robots that can go under the ocean and collect lava samples, such as Jason and Century. Some interesting things that I learned about Axial Seamount are that there is worms that live there that grow to be 8 feet called tube worms, and that there are crabs with really long legs that just climb over all the stuff.

Are tube worms found any other place?

Sincerely, Emilee B

Dear Bill & Jim,

The Skype call we made was a success. It was nice to actually talk and ask questions to real scientists. I learned a ton of stuff, I learned that there living organisms that can actually live without having a stomach and a mouth. It is also cool to know that you can control a robot under water from a mile away! But probably the most interesting was the fact that you have a cable that is a mile long! That is just insane! Another thing that I learned is that organisms can actually withstand that intense heat. A question that I have is is that is the axial seamount apart of the ring of fire?

Sincerely,
Desi Hawkins, CJHS student

Dear Bill Chadwick and Jim Holden,
Thank you for spending your time answering our questions. I've learned lots of interesting information. I was very surprised when I heard that the Jason robot was as big as a mini van. It was very intereseing to hear that the worms inhabited the lava tubes in a month. I heard that europe was developing some of the same technology that you use, so would the volcano that they use become a wired volcano.

Sincerely,
Mia

Dr. Chadwick and Dr. Holden,
Thankyou for taking the time to answer the questions from our class. It was an amazing experience to get to talk to live scientists who are in the ocean researching. I learned that shrimp don't have eyes. I thought everyone had eyes. I also learned alot about undersea volcanoes. I didn't know anything about these before. I also learned about tubeworms and how they live off of bacteria sacks inside of them. I had no idea they could get up to 3 feet long in Mexico? That is also one thing I found interesting. I also found it interesting that there were different crews for a.m. and p.m. shifts. Thats alot of people. You have to be super dedicated to the subject, so my question is did you always love Science or did you develope that passion later in life?

Sincerely,
-Anna Cu.

4.8 Hydrothermal Vent Fluid Temperature Recorders

Miniature temperature recorders (MTRs) are processed by Sharon Walker at NOAA/PMEL/EOI in Seattle, WA. The high-temperature recorders (MISO and HOBO) are processed by Bill Chadwick at OSU/CIMRS in Newport, OR.

Vent / Marker	Instrument	Dive Deployed	Dive Recovered	Comments	Hdg	VV#
RECOVERED						
Anemone vent	MTR 3317	J2-788	**J2-824**	Deployed 2014: little crack left of marker	150	10709
Casper	MISO 104	J2-788	**J2-824**	Deployed 2014: at base of marker	53	5620
Castle	MISO 101	J2-786	**J2-822**	Deployed 2014	21	2259
Marker 113 Vent	MTR 3201	J2-791	**J2-824**	deployed 2014: Mkr 62 not found	11	15031
Mkr-33 Site	MTR 3197	J2-790	**J2-822**	Deployed 2014	239	12271
Trevi	HOBO 153	J2-790	**J2-824**	Deployed 2014. Vent cap here in 2013, so no HOBO then	90	13934
Vixen	MISO 129	J2-788	**J2-824**	deployed 2014	102	5452
DEPLOYED						
Anemone vent	MTR 3043	**J2-824**		In nest of worms to right of flow/sampling site	177	4249
Castle	MISO 141	**J2-822**		In anhyhdrite.	320	1445
Marker 113 Vent	MTR 3173	**J2-824**		In 2015 sampling site.	323	5044
Mkr-33 Site	MTR 3052	**J2-825**		***See comments below***	270	5674
Trevi	MISO 101	**J2-824**		Same location as recovered 2014 HOBO	201	4683
Vixen	MISO 103	**J2-824**		In main orifice of Vixen.	211	5254
Diva	MISO 102	**J2-822**		Top of anhydrite mound; different heading than sampling but same location.	217	1368
Snow drift (NRZ)	MTR 4127	**J2-826**		With Marker 261 where fluids and mat were sampled on 2015 lava	357	6767

Mkr 33 comments: *MTR deployed in orifice sampled on J2-822 with white floc coming out of hole. MTR 3028 was initially deployed on J2-822, but then recovered on J2-825 because it did not have a marker float making it difficult to see. On J2-825, MTR 3052 was deployed with a marker float in the same location described for MTR3028 on J2-822.*

Note: MISO's 130 and 135 were lost during the recovery of dive J2-823

5 - Imagery

1. Automated Video Recordings
1716 clips comprising 1.8 TB

Three 1080i camera streams (brow camera, pilot camera, science camera) were recorded to hard drive---based video files. Raw videos are MPEG Transport Stream (.ts) files compressed (output rate was 6000 kbps) using the h.264 codec. Image resolution is 1920x1080 pixels. These are playable using open source video players such as VLC, mplayer, or totem. Filenames include camera name and start timestamp. Automated clip duration was set at 15 minutes. In addition to the video files, metadata broadcast in real---time on the Jason network was captured to subtitle files (.srt format). There are four subtitle files to choose from, each of which can produce a line of text overlain on the video. A fifth file captures the metadata in timestamped stanzas. Filenames are timestamped simultaneously (within milliseconds) of the video file.

Subtitle file 1: UTC time, real time latitude, real time longitude, heading, depth.
Subtitle file 2: vehicle ID, cruise ID, lowering ID, date
Subtitle file 3: localX, localY, roll, pitch, altitude
Subtitle file 4: origin latitude, origin longitude, UTM zone

These components were merged into a Matroska container file (.mkv). Components are provided in subdirectories.

2. High-Definition video highlights
164 clips comprising 276 GB
Direct---to---hard disk recordings of important moments were made from high definition video. The Jason data processor copied them to hard drives provided by the chief scientist. He also renamed the clips so that they indicate lowering ID, start time, and stop time. A summary listing of the clips is in the Documentation section. The recordings were compressed in real time using the ProRes422 family of codecs. They can be played back on your computer using video player software: examples include QuickTime player and appropriately compiled versions of the open source software VLCplayer. They can be edited using Final Cut or Adobe Premiere. The recording includes time code that is synchronized to the same time reference as the other logging computers in the Jason system. Post---processing guidance is offered in a white paper (Morin, 2010) that is available on the NDSF web site.

> *"HD Stills and Video Enhancement Techniques for the NDSF HD Camera Using Photoshop and Final Cut", M. Morin, http://www.whoi.edu/page.do?pid=51119*

Table 5-1 Video Highlights

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-820	1BTK243	2015/08/17 09:38	2015/08/17 09:41	Scicam	Octopus
J2-820	1BTK244	2015/08/17 09:51	2015/08/17 09:53	Scicam	Transition from old to new lava
J2-820	1BTK245	2015/08/17 09:53	2015/08/17 09:56	PilotCam	Transition from old to new lava and an octopus
J2-820	1BTK246	2015/08/17 11:10	2015/08/17 11:14	SciCam	Collection of J820-Geo-03 from sheet flow
J2-820	1BTK247	2015/08/17 11:56	2015/08/17 11:58	SciCam	Two worms in jumbled 2015 lava w/ white filamentous bacterial mat
J2-820	1BTK248	2015/08/17 12:03	2015/08/17 12:04	SciCam	New worm? Looks like a cross between palm worm and sulfide worm
J2-820	1BTK249	2015/08/17 13:36	2015/08/17 13:39	SciCam	Fissure – South of waypoint 5
J2-820	1BTK250				throwaway clip
J2-822	1BTK251	2015/08/20 23:14	2015/08/20 23:16	SciCam	Launch and Submersion
J2-822	1BTK252	2015/08/20 00:54	2015/08/20 00:58	SciCam	Marker 33 Vent, temperature probing
J2-822	1BTK253	2015/08/20 01:11	2015/08/20 01:17	SciCam	Looking around Marker 33 Vent
J2-822	1BTK254	2015/08/20 04:59	2015/08/20 05:51	SciCam	Looking at top of El Guapo
J2-822	1btk255	2015/08/20 05:02	2015/08/20 05:02	SciCam	Still at El Guapo
J2-822	1BTK256	2015/08/20 05:35	2015/02/20 05:38	SciCam	Sampling El Guapo with HFS, note worms around vent
J2-822	1BTK257	2015/08/20 06:14	2015/02/20 06:15	SciCam	Sampling Diva
J2-822	1BTK258	2015/08/20 06:27	2015/02/20 06:28	SciCam	Measuring Diva with Hobo #102
J2-822	1BTK259	2015/08/20 07:04	2015/08/20 07:06	SciCam	Castle Vent, measuring temp
J2-822	1BTK260	2015/08/20 07:08	2015/08/20 07:09	SciCam	Flushing HFS pump at Castle
J2-822	1BTK261	2015/08/20 07:14	2015/08/20 07:16	SciCam	Sampling HFS, piston #4 at Castle
J2-822	1BTK262	2015/08/20 07:24	2015/08/20 07:25	SciCam	sampling HFS, GTB Red #9 at Castle
J2-822	1BTK263	2015/08/20 07:30	2015/08/20 07:33	SciCam	deployment of HOBO 141 at Castle, first arm
J2-822	1BTK264	2015/08/20 07:34	2015/08/20 07:36	SciCam	deployment of HOBO 141 at Castle, second arm

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-822	1BTK265	2015/08/20 07:46	2015/08/20 07:48	SciCam	arriving at El Gordo and looking at instruments
J2-822	1BTK266	2015/08/20 10:37	2015/08/20 10:40	SciCam	contact zone between 2015 and older flow near Waypoint #1
J2-822	1BTK267	2015/08/20 10:57	2015/08/20 11:02	SciCam	sample GEO 20 contact West of Waypoint 1
J2-822	1BTK268	2015/08/20 11:28	2015/08/20 11:30	SciCam	2015 Exploded Lobes
J2-822	1BTK269	2015/08/20 11:54	2015/08/20 11:55	SciCam	Contact
J2-822	1BTK270	2015/08/20 11:59	2015/08/21 12:02	SciCam	Traversing edge of the flow
J2-822	1BTK271	2015/08/21 12:10	2015/08/21 12:12	SciCam	attempt at sample, abort due to crumbling
J2-822	1BTK272	2015/08/21 12:15	2015/08/21 12:19	SciCam	Sample GEO-21
J2-822	1BTK273	2015/08/21 12:45	2015/08/21 12:50	SciCam	Western Edge of flow
J2-822	1BTK274	2015/08/21 13:04	2015/08/21 13:06	SciCam	Pillars and Shelf at eastern channel edge
J2-822	1BTK275	2015/08/21 13:10	2015/08/21 13:12	SciCam	Lava pillars
J2-822	1BTK276	2015/08/21 13:13	2015/08/21 13:14	SciCam	Lava pillars continued
J2-822	1BTK277	2015/08/21 13:20	2015/08/21 13:21	SciCam	Pillars and Roof
J2-822	1BTK278	2015/08/21 13:24	2015/08/21 13:29	SciCam	Contact and Skylight; Sample GEO-22
J2-822	1BTK279	2015/08/21 14:01	2015/08/21 14:02	SciCam	Crab!
J2-822	1BTK280	2015/08/21 14:18	2015/08/21 14:20	SciCam	lava pillars and mat
J2-822	1BTK281	2015/08/21 15:24	2015/08/21 15:28	SciCam	dropped a weight
J2-822	1BTK282	2015/08/21 15:42	2015/08/21 15:44	SciCam	Landed, looking at lavas that Begum landed on, jelly!
J2-822	1BTK283	2015/08/21 15:47	2015/08/21 15:51	SciCam	Begum picking up rock, rock is really crumbly, falls apart when touched
J2-822	1BTK284	2015/08/21 16:11	2015/08/21 16:12	SciCam	Island of old lavas surrounded by new lava
J2-822	1BTK285	2015/08/21 16:31	2015/08/21 16:33	SciCam	Old lava contact new lava
J2-822	1BTK286	2015/08/21 17:05	2015/08/21 17:06	SciCam	Several areas of new and old lava contact
J2-822	1BTK287	2015/08/21 17:26	2015/08/21 17:27	SciCam	Sediment covered new lobate flow

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-822	1BTK288	2015/08/21 17:42	2015/08/21 17:42	SciCam	Accidentally hit record before sampling.
J2-822	1BTK289	2015/08/21 17:47	2015/08/21 17:49	SciCam	Heavily microbial-mat coated and sedimented new lobate flow sample, GEO-24 at Wp 5
J2-822	1BTK290	2015/08/21 18:14	2015/08/21 18:16	SciCam	Contact between old and new flow. Heading northeast along contact
J2-822	1BTK291	2015/08/21 18:16	2015/08/21 18:23	PilotCam	Contact between old and new flow. Heading northeast along contact
J2-822	1BTK292	2015/08/21 21:21	2015/08/21 21:28	SciCam	T&S vent in CASM field
J2-822	1BTK293	2015/08/21 21:28	2015/08/21 21:31	SupScorpio	Sampling T&S vent with Major
J2-822	1BTK294	2015/08/21 21:31	2015/08/21 21:35	PilotCam	Sampling T&S vent with Major
	1BTK295				throwaway clip
J2-823	1BTK296	2015/08/22 15:07	2015/08/22 15:11	SciCam	Jason launch
J2-823	1BTK297	2015/08/22 16:38	2015/08/22 16:41	SciCam	Deploying miniBPR #13 blue/black at AX-105 benchmark
J2-823	1BTK298	2015/08/22 16:42	2015/08/22 16:47	SciCam	Pressure recorder at AX-105 benchmark
J2-823	1BTK299	2015/08/22 20:58	2015/08/22 20:13	SciCam	Pressure recorder at AX-104 (Mkr-65) benchmark
J2-823	1BTK300	2015/08/23 01:07	2015/08/23 01:13	SciCam	Pressure recorder at AX-303 (Mkr-66) benchmark
J2-823	1BTK301	2015/08/23 02:36	2015/08/23 02:40	SciCam	Pressure recorder at AX-309 (Mkr-130) benchmark
J2-823	1BTK302				throwaway clip
J2-823	1Btk303				throwaway clip
J2-823	1btk304	2015/08/23 04:22	2015/08/23 04:26	SciCam	Benchmark AX-302 (mkr63); place P recorder
J2-823	1btk305	2015/08/23 04:48	2015/08/23 04:52	SciCam	Installing mini-BPR at AX-302 (yellow)
J2-823	1BTK306	2015/08/23 06:52	2015/08/23 06:54	SciCam	Benchmark AX 101, starting P recorder placement
J2-823	1BTK307	2015/08/23 10:21	2015/08/23 10:24	SciCam	Copepod vs. brittlestar
J2-823	1BTK308	2015/08/23 11:06	2015/08/23 11:08	SciCam	SCPR
J2-823	1BTK309	2015/08/23 11:18	2015/08/23 11:20	SciCam	Leaving bottom, observing SCPR mooring float
J2-823	1BTK310	2015/08/23 13:03	2015/08/23 13:05	SciCam	Approaching AX-308

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-823	1BTK311	2015/08/23 13:34	2015/08/23 13:37	SciCam	Mini BPR #8 placement at AX-306 and departure
	1BTK312				throwaway clip
J2-823	1BTK313	2015/08/23 15:52	2015/08/23 15:54	SciCam	Second pressure recorder at AX-106 benchmark
J2-823	1BTK314	2015/08/23 20:02	2015/08/23 20:03	SciCam	J2-823-GEO-1, suction sample of “ash” at AX-101 benchmark
J2-823	1BTK315	2015/08/23 20:03	2015/08/23 20:05	SciCam	More J2-823-GEO-1, suction sample of “ash” at AX-101 benchmark
J2-823	1BTK316	2015/08/24 01:51	2015/08/24 01:53	SciCam	Rat Tail investigating BPR
J2-823	1BTK317	2015/08/24 03:21	2015/08/24 03:24	SciCam	Placing, measuring MPR at AX309
J2-823	1BTK318	2015/08/24 05:03	2015/08/24 05:11	SciCam	Placing blue Mini BPR; placing, measuring MPR at AX303
J2-823	1BTK319	2015/08/24 06:41	2015/08/24 06:46	SciCam	Placing and recording MPR at AX 310
J2-824	1BTK320	2015/08/24 19:06	2015/08/24 19:09	BrowCam	Jason launch J2-824
J2-824	1BTK321	2015/08/24 21:27	2015/08/24 21:33	SciCam	Inferno
J2-824	1BTK322	2015/08/24 21:14	2015/08/25 21:15	SciCam	Approaching Virgin
J2-824	1BTK323	2015/08/25 22:18	2015/08/01 22:20	SciCam	Virgin
J2-824	1BTK324	2015/08/24 22:23	2015/08/01 22:25	SciCam	Virgin Take 2.
J2-824	1BTK325	2015/08/24 22:46	2015/08/24 22:48	SciCam	Virgin vent before sampling
J2-824	1BTK326	2015/08/24 22:52	2015/08/24 22:53	SciCam	HFS sample at Virgin vent
J2-824	1BTK327	2015/08/24 23:03	2015/08/24 23:05	SciCam	GTB sample at Virgin
J2-824	1BTK328	2015/08/24 23:12	2015/08/24 23:13	SciCam	Phoenix
J2-824	1BTK329	2015/08/24 23:15	2015/08/24 23:17	SciCam	Anemone
J2-824	1BTK330	2015/08/24 23:19	2015/08/24 23:19	SciCam	Jason temperature in chimlet at Anemone
J2-824	1BTK331	2015/08/24 23:44	2015/08/24 23:46	SciCam	HFS sampling at Anemone
J2-824	1BTK332	2015/08/25 00:16	2015/08/25 00:17	SciCam	Placing the MTR 3043 at Anemone
J2-824	1BTK333	2015/08/25 00:22	2015/08/25 00:23	SciCam	Leaving Anemone

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-824	1BTK334	2015/08/25 00:50	2015/08/25 00:51	SciCam	MPR placement at AX-106
J2-824	1BTK335	2015/08/25 04:12	2015/08/25 04:17	SciCam	Placing MPR at AX-307 (also says Mkr 127)
J2-824	1BTK336	2015/08/25 05:57	2015/08/25 06:11	SciCam	Placing MPR recording at AX 101
J2-824	1BTK337	2015/08/25 08:15	2015/08/25 08:16	SciCam	Placing MPR recording at AX 302
J2-824	1BTK338	2015/08/25 08:41	2015/08/25 08:44	SciCam	Spanish Steps over to Trevi
J2-824	1BTK339	2015/08/25 09:16	2015/08/25 09:19	SciCam	Spanish Steps fly by
J2-824	1BTK340	2015/08/25 11:01	2015/08/25 11:02	SciCam	AX-303 MPR placement
J2-824	1BTK341	2015/08/25 12:57	2015/08/25 12:59	SciCam	AX-308 MPR placement
J2-824	1BTK342	2015/08/25 14:49	2015/08/25 14:51	SciCam	Arriving at Mkr 113 vent site
J2-824	1BTK343	2015/08/25 15:00	2015/08/25 15:03	SciCam	HFS sample at Mkr 113 vent site
J2-824	1BTK344	2015/08/25 15:14	2015/08/25 15:15	SciCam	Worms and other life at Mkr113 vent site
J2-824	1BTK345	2015/08/25 15:24	2015/08/25 15:26	SciCam	Clam beds at Mkr113.
J2-824	1BTK346	2015/08/25 15:56	2015/08/25 15:57	SciCam	More worms and diffuse flow at Mkr 113
J2-824	1BTK347	2015/08/25 16:00	2015/08/25 16:02	SciCam	Anemone at Mkr 113
J2-824	1BTK348	2015/08/25 16:52	2015/08/25 16:53	SciCam	Overview of Mkr113 to compare to previous years (short clip)
J2-824	1BTK349	2015/08/25 17:06	2015/08/25 17:09	SciCam	Overview of Mkr113 to compare to previous years (good clip)
J2-824	1BTK350	2015/08/25 17:55	2015/08/25 17:55	SciCam	Crab with Brittlestars
J2-824	1BTK351	2015/08/25 18:01	2015/08/25 18:04	SciCam	Vixen smoker with HOBO Mkr 129
J2-824	1BTK352	2015/08/25 18:15	2015/08/25 18:17	SciCam	J2-824-GTB 21 (green/red #?) sample at Vixen
J2-824	1BTK353	2015/08/25 18:19	2015/08/25 18:20	SciCam	HFS sample at Vixen
J2-824	1BTK354	2015/08/25 18:30	2015/08/25 18:32	SciCam	Deploying HOBO at Vixen
J2-824	1BTK355	2015/08/25 18:42	2015/08/25 18:43	SciCam	Vigorous flow at Vixen
J2-824	1BTK356	2015/08/25 18:47	2015/08/25 18:48	SciCam	Arrival at Casper, Chimney

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-824	1BTK357	2015/08/25 18:50	2015/08/25 18:52	SciCam	Recovering HOBO MIS0-104
J2-824	1BTK358	2015/08/25 18:54	2015/08/25 18:55	SciCam	Temperature probe and flow at Casper, T=298.0
J2-824	1BTK359	2015/08/26 02:01	2015/08/26 02:06	SciCam	Benchmark at South Pillow Mound.
	1BTK360				throwaway clip
J2-825	1BTK361	2015/08/26 16:33	2015/08/26 16:35	SciCam	Beast Temp Probe at Marker 33 vent
J2-825	1BTK362	2015/08/26 18:28	2015/08/26 18:32	SciCam	Beast wand at mkr-33 (166) HFS sampling
J2-825	1BTK363	2015/08/26 18:41	2015/08/26 18:43	SciCam	Floc from vent at mkr- 33 vent while sampling (HFS8)
J2-825	1BTK364	2015/08/26 20:16	2015/08/26 20:17	SciCam	Boca flyby
J2-825	1BTK365	2015/08/26 07:28	2015/08/15 07:32	SciCam	New lava contact
J2-825	1BTK366	2015/08/26 07:36	2015/08/26 07:36	SciCam	Kelp-like thing
J2-825	1BTK367	2015/08/26 08:00	2015/08/26 08:03	SciCam	Contact with new lava again
J2-825	1BTK368	2015/08/26 09:49	2015/08/26 09:50	SciCam	Contact with new lava again
J2-825	1BTK369	2015/08/26 11:02	2015/08/26 11:05	SciCam	Jason recovery (at night) – at the surface still in the water
J2-825	1BTK370	2015/08/26 11:08	2015/08/26 11:10	SciCam	Jason recovery (at night) – but powered off too soon!
J2-826	1BTK371	2015/08/27 19:34	2015/08/27 19:39	SciCam	Jason launch J2-826
J2-826	1BTK372	2015/08/27 21:09	2015/08/27 21:10	SciCam	Marker 294 highlight
J2-826	1BTK373	2015/08/27 21:21	2015/08/27 21:23	SciCam	Installing RAS
J2-826	1BTK374	2015/08/27 22:35	2015/08/27 21:38	SciCam	Installing RAS – 2 (imploded bottle)
J2-826	1BTK375	2015/08/27 22:58	2015/08/27 23:00	SciCam	White floc
J2-826	1BTK376	2015/08/27 23:23	2015/08/27 23:24	SciCam	Leaving RAS deployment site, headed to WPT 5
J2-826	1BTK377	2015/08/27 23:27	2015/08/27 23:32	SciCam	transiting to waypoint 5, venting, tubeworms
J2-826	1BTK378	2015/08/27 23:32	2015/08/27 23:35	SciCam	Fissure – South of waypoint 5
J2-826	1BTK379	2015/08/27 23:45	2015/08/27 23:47	SciCam	End of fissure, some venting

Dive Number	KiPro HD recorder name	Start time (log)	End time (log)	Camera Source (BrowCam, SciCam, PilCam,SupScorp)	Notes of Activity or Feature in Clip
J2-826	1BTK380	2015/08/27 23:49	2015/08/27 23:51	SciCam	Small fissure
J2-826	1BTK381	2015/08/28 00:00	2015/08/28 00:09	SciCam	Thick bacterial mat with venting
J2-826	1BTK382	2015/08/28 00:20	2015/08/28 00:23	SciCam	Suctioning bacterial mat from 2015 flow near waypoint 5
J2-826	1BTK383	2015/08/28 00:34	2015/08/28 00:36	SciCam	Unfiltered Piston #2 sample from 2015 flow near wpt. 5
J2-826	1BTK384				throwaway clip
J2-826	1BTK385	2015/08/28 01:31	2015/08/28 01:33	SciCam	Transiting to waypoint 6
J2-826	1BTK386	2015/08/28 01:40	2015/08/28 01:42	SciCam	Attempting j826-GEO -13 sample
J2-826	1BTK387	2015/08/28 02:12	2015/08/28 02:16	SciCam	Jumbled 2015 lava flow
J2-826	1BTK388	2015/08/28 02:29	2015/08/28 02:33	SciCam	Geo sample attempt. 25 meters S-SE of wpt 7
J2-826	1BTK389	2015/08/28 03:15	2015/08/28 03:18	SciCam	J2-826-GEO-15, small pillow near wpt 8
J2-826	1BTK390	2015/08/28 03:27	2015/08/28 03:28	SciCam	Contact between 2015 lava and old lava
J2-826	1BTK391	2015/08/28 03:41	2015/08/28 03:41	SciCam	Quick clip from old to new contact
J2-826	1BTK392	2015/08/28 03:52	2015/08/29 03:52	SciCam	J2-826-GEO-16, round lava bud from base of pillow near wpt 10
J2-826	1BTK393	2015/08/28 04:08	2015/08/28 04:10	SciCam	Thick microbial mat on new flow
J2-826	1BTK394	2015/08/28 04:11	2015/08/28 04:13	SciCam	Bright white areas of mat with shimmering water venting
J2-826	1BTK395	2015/08/28 04:30	2015/08/28 04:31	SciCam	Same vent but from broader view
J2-826	1BTK396	2015/08/28 04:32	2015/08/28 04:34	SciCam	Close-up of white flocs coming off of vent
J2-826	1BTK397	2015/08/28 04:38	2015/08/28 04:39	SciCam	J2-826-HFS-17 sampling. Unfiltered piston #4
J2-826	1BTK398	2015/08/28 04:50	2015/08/28 04:51	SciCam	J2-826-major-18, Red
J2-826	1BTK399	2015/08/28 04:53	2015/08/28 04:55	SciCam	Rock sample at new vent, too big, threw away
J2-826	1BTK400	2015/08/28 04:57	2015/08/28 04:59	SciCam	J2-826-GEO-19, small rock sample near new vent
J2-826	1BTK401	2015/08/28 05:14	2015/08/28 05:15	SciCam	Flyover at WPT 11
J2-826	1TBK402	2015/08/28 05:42	2015/08/28 05:43	SciCam	J2-826-GEO-20, pillow broke into two pieces in basket

6 – JASON

Compiled by Andra Bobbitt, OSU CIMRS

6.1 Jason Dive Statistics:

Dive	Start/Launch	Start Data	End Data	End/On Deck	Line/Area/Site	Data Time (Hrs:Mns)	Bottom Time (Hrs:Mns)
J2-820	2015/08/17 07:10	2015/08/17 08:20	2015/08/17 14:02	2015/08/17 15:41	North Rift Zone	5:42	8:31
J2-821	2015/08/18 00:46	2015/08/18 02:01	2015/08/18 02:07	2015/08/18 03:23	North Rift Zone	0:06	2:37
J2-822	2015/08/20 23:15	2015/08/21 00:41	2015/08/21 21:35	2015/08/21 23:04	M33-International District	20:54	23:49
J2-823	2015/08/22 15:08	2015/08/22 16:24	2015/08/24 09:06	2015/08/24 11:07	Benchmark Pressure Readings	40:42	43:59
J2-824	2015/08/24 19:08	2015/08/24 21:15	2015/08/26 02:27	2015/08/26 03:31	Benchmark Pressure Readings	29:12	32:23
J2-825	2015/08/26 15:05	2015/08/26 16:15	2015/08/27 09:58	2015/08/27 11:11	M33 vent- Boca vent - North Caldera	17:43	20:06
J2-826	2015/08/27 19:37	2015/08/27 20:48	2015/08/28 05:52	2015/08/28 07:06	North Rift Zone	9:04	11:29
					TOTAL:	123:23	142:54

6.2 Jason Dive Summaries

DIVE J2-820 North Rift Zone

Main goals: Rock sampling and fluid sampling on the new lava flows

Samples:
8 total; 4 geology; 2 fluid; 2 gas

Tasks Accomplished:
1) Explored North Rift Zone 2015 lava flow. Dive started just south of the southern of the two thick NRZ lava flows and traversed from south to north along the apparent eruptive fissure, from waypoints 1-4. Documented various thicknesses of the flow and some contacts between old/new lavas. Went to the summit of the thickest lava mound in this portion of the 2015 flow. Observed eruptive mat, glassy flows but no hydrothermal flow.
2) Sampled lavas and venting fluids spatially distributed along eruptive fissure during traverse from south to north.

DIVE J2-822 Fluid Sampling at Mkr-33 Site and International District & Sampling 2015 Flows

Main goals: (1) Fill Beast incubator at Marker33 site; (2) Sample fluids at International District vents; (3) Sample 2015 lava flows in NE Caldera

Samples:
26 total; 17 fluid; 6 geology; 3 gas

Tasks Accomplished:
1) Filled Beast incubator, 4 samples, at Marker 33 Site (Mkr-166), then large-volume-bag and 5 other fluid samples.
2) At Marker 33 Site, Recovered MTR 3197; Deployed MTR 3028

3) Transit to International District with bottom in site but at high speed, no stopping.
4) Sampled vent fluids at these International District vents:
El Guapo (1 GTB, 1 Major, 2 HFS), Diva (1 GTB, 2 HFS), Castle (1 GTB, 1 HFS)
5) Deployed HOBO 102 at Diva vent
6) At Castle vent, recovered HOBO 101 and deployed HOBO 141
7) Examined El Gordo with RAS and other OOI instruments.
8) Transited in water column to NE Caldera 2015 lava flow area (WP1), began at old/new contact.
9) Collected 6 rock samples of 2015 lava flows in NE Caldera during transit through waypoints 1-6.
10) No observable hydrothermal venting in the new lavas.
11) Deployed Mkr-246 and Mkr-275 near waypoint #5 and at J822-Geo-24 sample site; deployed markers 240, 242 and 260 at J822-Geo-25 sample site for ROV weight management, not navigation purposes.
12) At CASM, observed Shepherd and T&S vent areas and took one major sample at T&S.

DIVE J2-823 Benchmark Pressure Measurements

Main goals: (1) Made pressure measurements at seafloor benchmarks and transited in the water column between sites; making 2 transects and will collect Reson multibeam at 100 m altitude during transits of the 1st transect; (2) Deployed 6 mini-BPRs (5 lbs. each) at selected benchmarks; (3) Attempt to release and recover the SCPR mooring, (4) Sample vent fluids at selected sites on the last pressure transect, (5) Recover & deploy HOBO and MTR temp probes

Samples:
2 total; 2 geology

Tasks Accomplished:
1) Pressure measurements at seafloor benchmarks. Almost two transects in the order in the table below (S->N, then N->S, with last measurement at AX-104)) before Jason hydraulic leak.
2) Deployed mini-BPRs at AX-105, AX-303, AX-302, AX-307, AX-106, and AX-308
3) Sampled some dust off the AX-101 benchmark with suction sampler, speculating the particles were ash from the eruption.
4) Collected multibeam sonar @ 100 m altitude during transits of 1st transect.
5) Successfully communicated with SCPR at close range and released mooring to surface
6) Took one geology sample near AX-309 benchmark for ballast.

DIVE J2-824 Finish Pressure Measurements & Fluid Sampling

Main goals: (1) Finish pressure measurements at seafloor benchmarks; (2) Sample vent fluids at selected sites, (3) Recover & deploy HOBO and MTR temp probes.

Samples:
24 total: 21 fluid; 3 gas.

Tasks Accomplished:
1) ASHES: Sampled fluids at Inferno (3 HFS), Virgin (2 HFS, 1 GTB), and Anemone (3 HFS). Recovered MTR 3317 and deployed MTR 3043 at Anemone.
2) Pressure measurements: AX-106, AX-308, AX-307, AX-101, AX-302.
3) Trevi: Recovered HOBO 153; Sampled 2 HFS and one GTB; Deployed HOBO-101; Viewed Spanish Steps.
4) Pressure measurement: AX-303, AX-308
5) Mkr 113 Vent: Sampled 8 HFS. Deployed MTR 3173 and recovered MTR 3201.
6) Vixen: Recovered MISO 129. 2 HFS and one GTB sampled; Deployed HOBO 103.
7) Casper: Recovered MISO 104. One HFS
8) Pressure measurement: AX-104, AX-105.

DIVE J2-825 Incubator sample at Mkr-33 Site and North Rim exploration

Main goals: (1) Fill Beast incubator at Marker 33, (2) Visit Boca vent, (3) Transit to BPR-Center, release and recover, (4) Transit to north caldera rim explore for hydrothermal vents and sample 2015 lava flows

Samples:
17 total: 9 HFS and 8 geology.

Tasks Accomplished:
1) Mkr-33 Vent site: Filled Beast incubator (4), LVB and 3 other HFS samples. Deployed MTR 3052 and recovered MTR 3028 (replaced MTR deployed on J2-823 which didn't have a float and was difficult to see)
2) Boca: took temperature reading only, no sampling.
3) Transited to BPR-Center and waited while deploying Sentry.
4) Release and recover BPR-Center.
5) Transited to North Caldera Rim Waypoints
6) Collected 8 rock samples from 2015 lava flows.

DIVE J2-826 North Rift Zone 2015 Lava Flows

Main goals: Rock sampling and fluid sampling on the 2015 lava flows

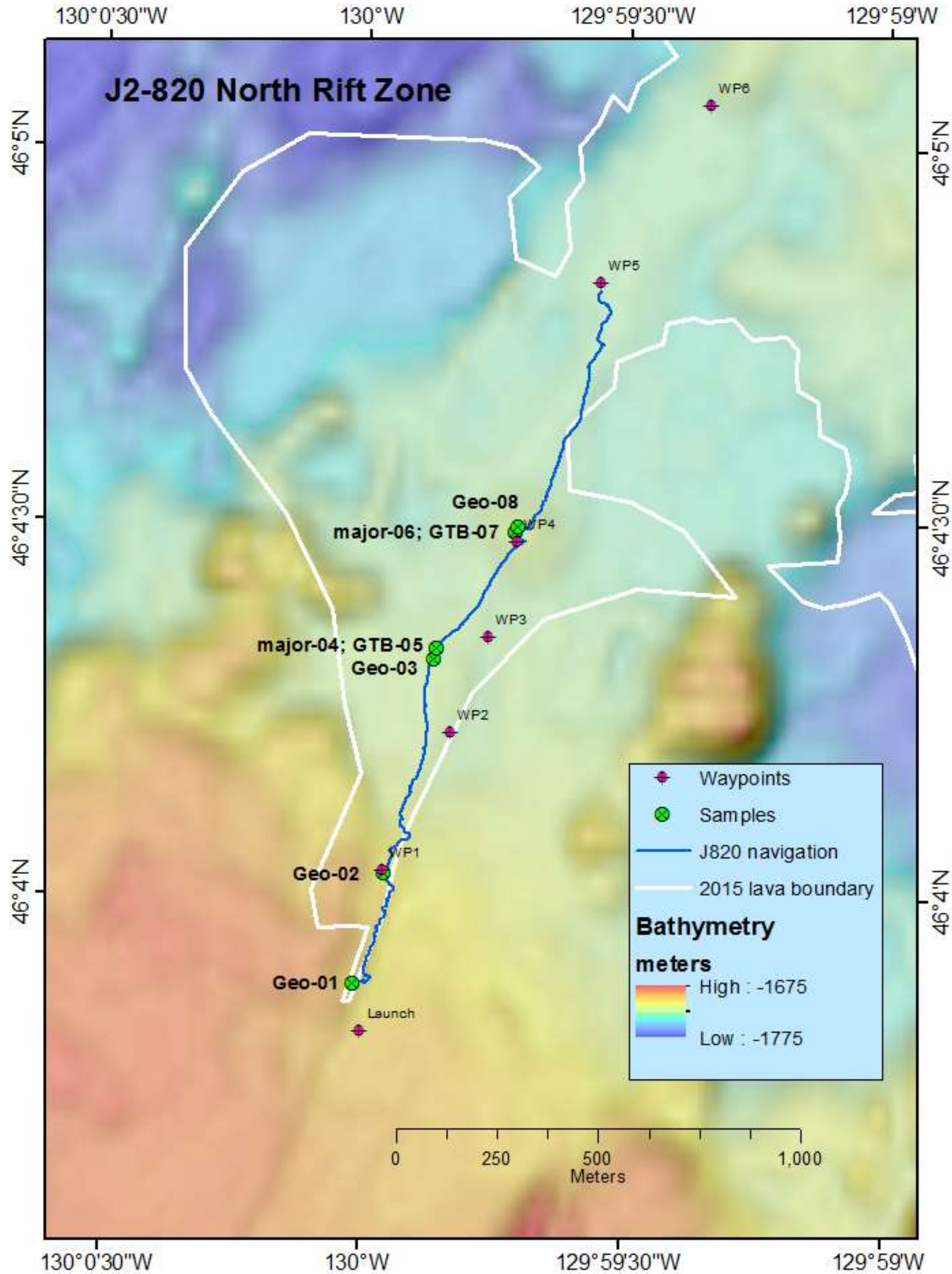
Samples:
20 total: 11 HFS, 7 geology, 1 gas, 1 biology

Tasks Accomplished:
1) Deployed Mkr-294 at RAS deployment site on, previously sampled on J2-820.
2) Took samples at the RAS/Mkr-294 site. Repositioned the RAS from its deployment site to the Mkr-294 location.
3) Explored North Rift Zone 2015 lava flows from RAS site heading toward WP-5. Dive is resuming where J2-820 left off (WP4) on the southern of the two thick NRZ lava flows. Traversed from south to north along the apparent eruptive fissure (WP-9 was eliminated from the transit).
4) Sampled orange bacterial mat, fluids and lava just before reaching WP-5. Deployed Mkr-261 in thick mat site, named Snowdrift.
5) Continued lava sampling near waypoints distributed along eruptive fissure during traverse from south to north.
6) Sampled lava and fluids at site emitting floc with shimmering water in lava mound, near WP-11.
7) Finished dive just before WP-12 with a lava sample.

6.3 Dive Maps

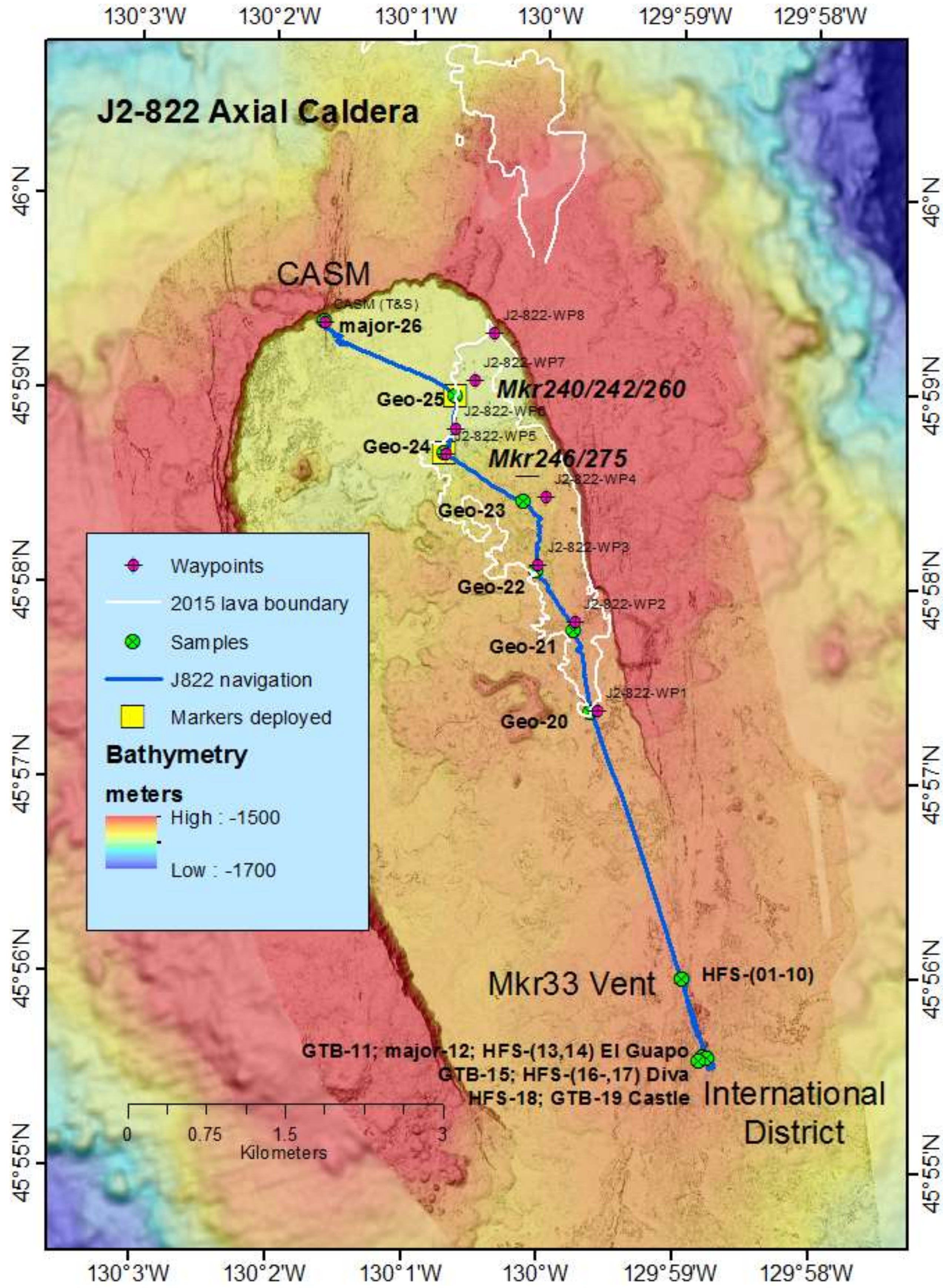
Bathymetry data on the dive maps was provided by MBARI and is a compilation of AUV bathymetric data collected through 2011 unless otherwise indicated. Dive navigation data were provided at sea by WHOI JASON group utilizing USBL navigation data post-processed using the WHOI renav process which combines the USBL data and Doppler positioning information. Vent and marker positions have been compiled by the PMEL EOI group for numerous years based on the best information available from bathymetry and site visits spanning many years and vehicles. Sample positions were taken from the best observed position from JASON while sitting in one place during the dive (cursor position provided by the Jason navigator) for most sampling sites (see the sample tables). Maps are displayed with a UTM zone 9 projection using ArcMap GIS. Mooring positions are drop positions, except for the OBH mooring which was surveyed using the WorkBoat software, and except for the RAS mooring which was repositioned on the seafloor by Jason.

6.3.1 J2-820

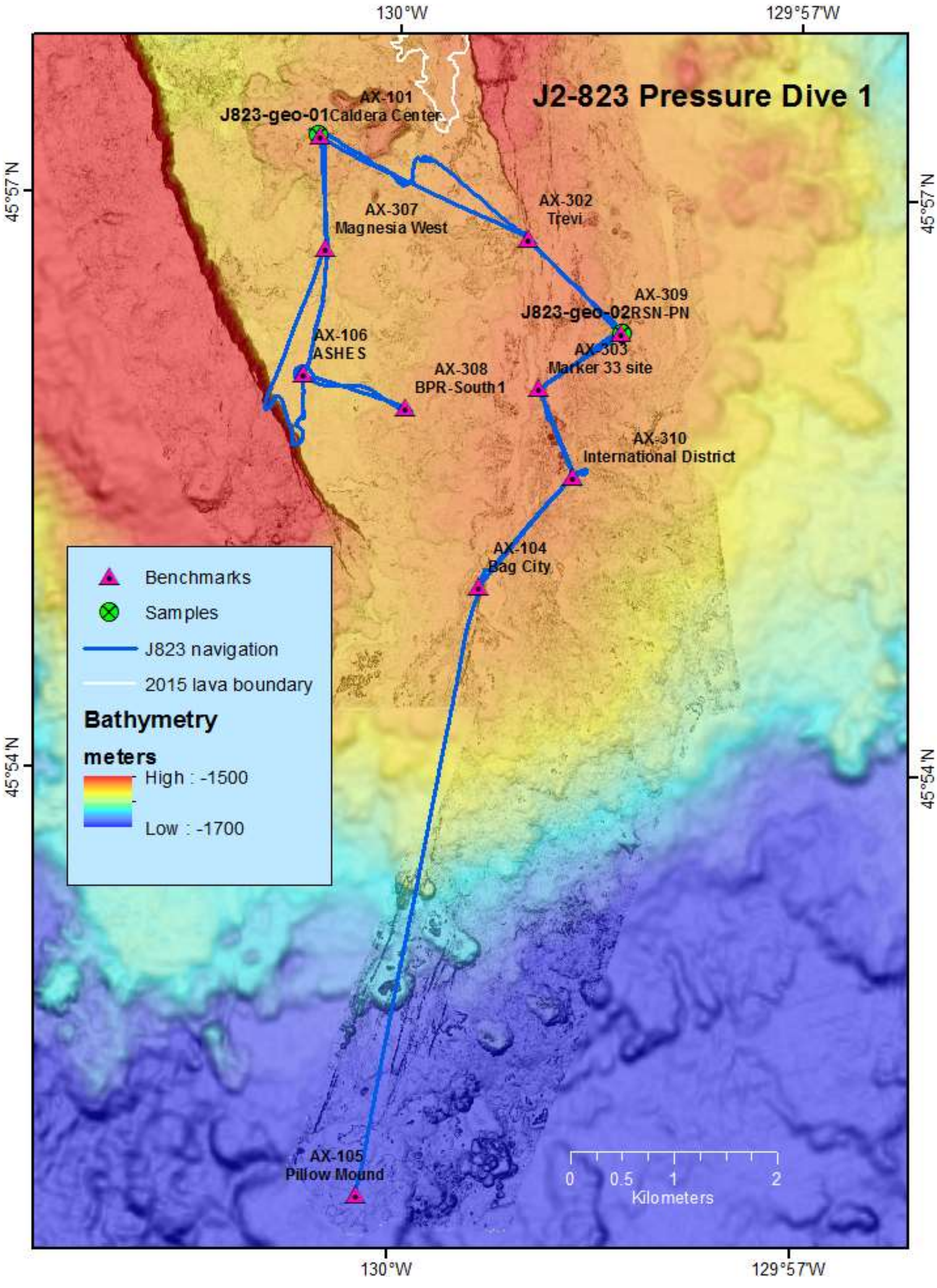


J2-820 North Rift Zone
130°0'30"W
130°W
129°59'30"W
129°59'W
46°5'N
46°4'30"N
46°4'N
WP6
WP5
WP4
WP3
WP2
WP1
Launch
Geo-08
major-06; GTB-07
major-04; GTB-05
Geo-03
Geo-02
Geo-01
Waypoints
Samples
J820 navigation
2015 lava boundary
Bathymetry
meters
High : -1675
Low : -1775
0
250
500
1,000
Meters

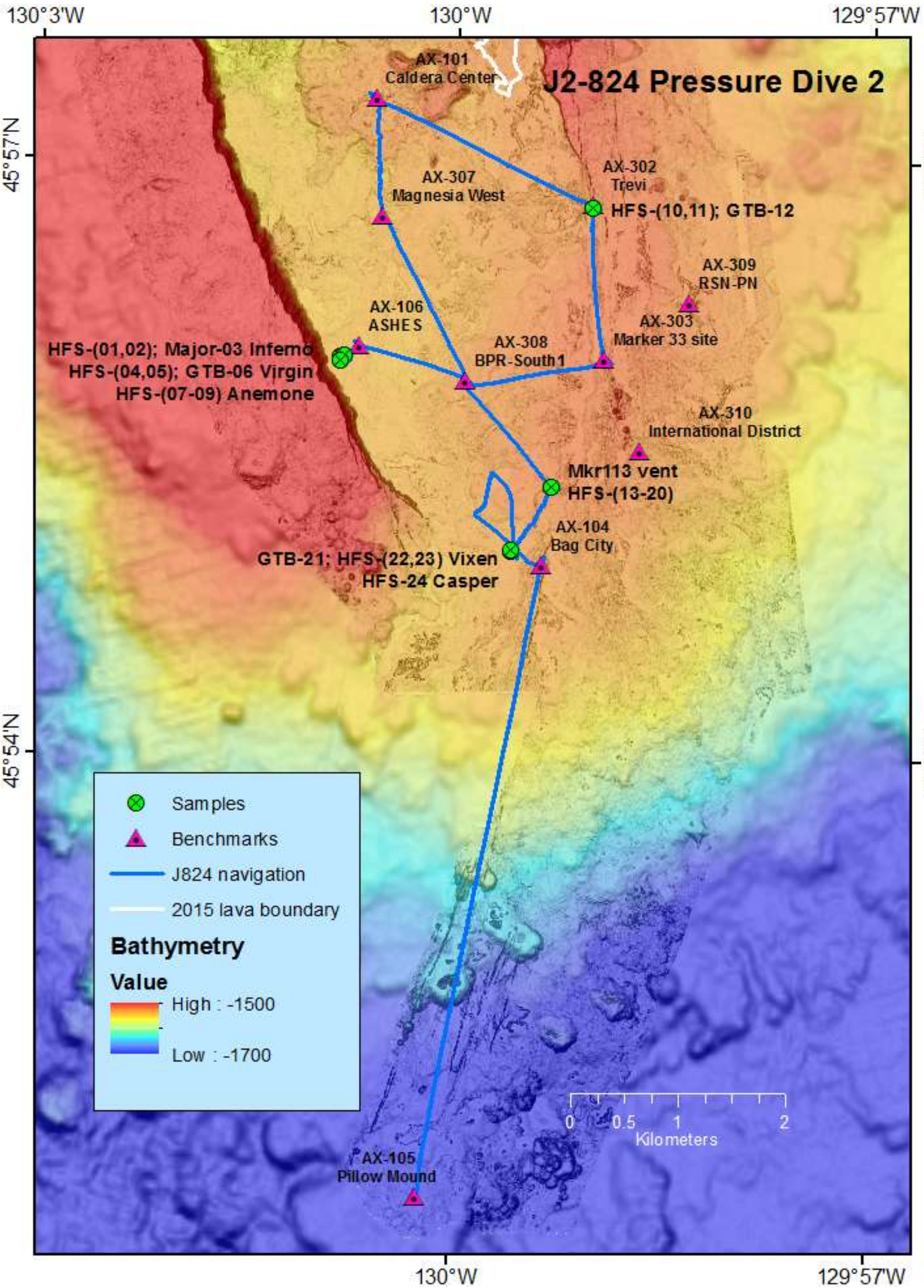
6.3.2 J2-822


J2-822 Axial Caldera
130°3'W
130°2'W
130°1'W
130°W
129°59'W
129°58'W
46°N
45°59'N
45°58'N
45°57'N
45°56'N
45°55'N
CASM
CASM (T&S)
major-26
J2-822-WP8
J2-822-WP7
Mkr240/242/260
Geo-25
J2-822-WP6
J2-822-WP5
Geo-24
Mkr246/275
J2-822-WP4
Geo-23
J2-822-WP3
Geo-22
J2-822-WP2
Geo-21
J2-822-WP1
Geo-20
Waypoints
2015 lava boundary
Samples
J822 navigation
Markers deployed
Bathymetry
meters
High : -1500
Low : -1700
Mkr33 Vent
HFS-(01-10)
GTB-11; major-12; HFS-(13,14) El Guapo
GTB-15; HFS-(16-,17) Diva
HFS-18; GTB-19 Castle
International District
0
0.75
1.5
3
Kilometers

6.3.3 J2-823

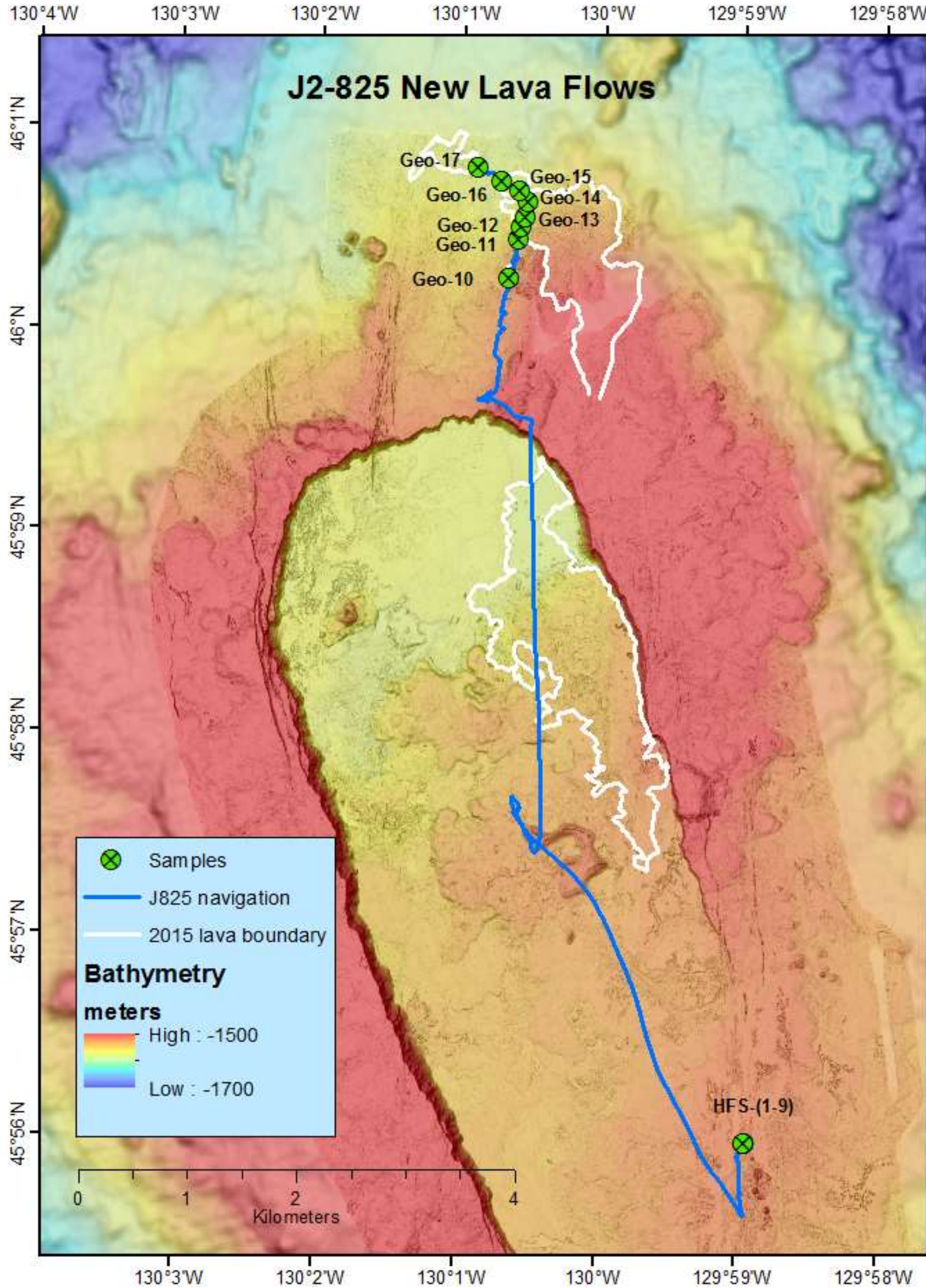

130°W
129°57'W
45°57'N
45°54'N
J2-823 Pressure Dive 1
AX-101
Caldera Center
J823-geo-01
AX-307
Magnesia West
AX-302
Trevi
AX-309
RSN-PN
J823-geo-02
AX-106
ASHES
AX-303
Marker 33 site
AX-308
BPR-South1
AX-310
International District
AX-104
Bag City
AX-105
Pillow Mound
Benchmarks
Samples
J823 navigation
2015 lava boundary
Bathymetry
meters
High : -1500
Low : -1700
0 0.5 1 2
Kilometers

6.3.4 J2-824



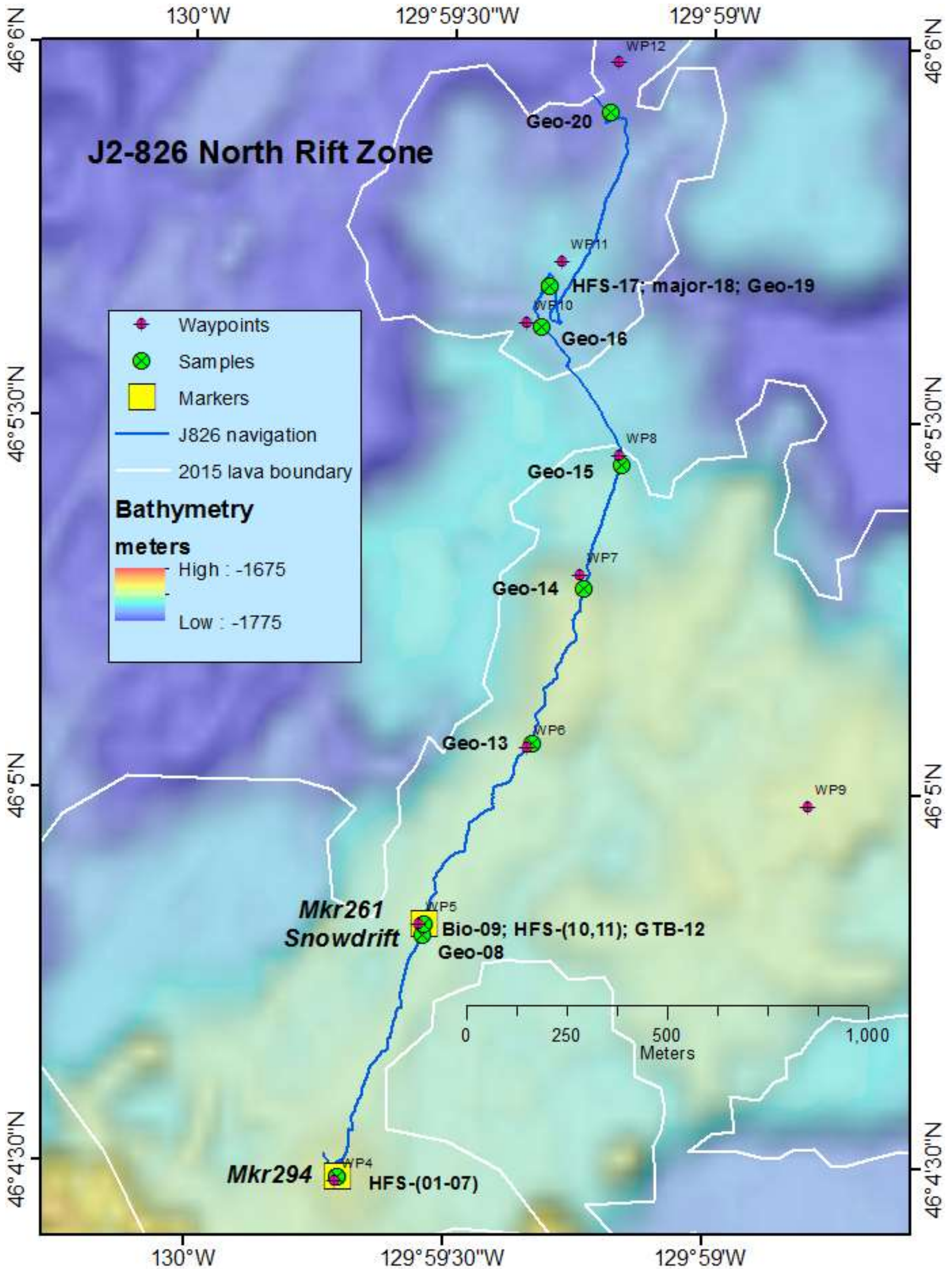
130°3'W
130°W
129°57'W
45°57'N
45°54'N
J2-824 Pressure Dive 2
AX-101
Caldera Center
AX-307
Magnesia West
AX-302
Trevi
HFS-(10,11); GTB-12
AX-309
RSN-PN
AX-106
ASHES
AX-303
Marker 33 site
AX-308
BPR-South1
HFS-(01,02); Major-03 Inferno
HFS-(04,05); GTB-06 Virgin
HFS-(07-09) Anemone
AX-310
International District
Mkr113 vent
HFS-(13-20)
AX-104
Bag City
GTB-21; HFS-(22,23) Vixen
HFS-24 Casper
Samples
Benchmarks
J824 navigation
2015 lava boundary
Bathymetry
Value
High : -1500
Low : -1700
0 0.5 1 2
Kilometers
AX-105
Pillow Mound

6.3.5 J2-825



J2-825 New Lava Flows
Geo-17
Geo-16
Geo-15
Geo-14
Geo-13
Geo-12
Geo-11
Geo-10
HFS-(1-9)
Samples
J825 navigation
2015 lava boundary
Bathymetry
meters
High : -1500
Low : -1700
0
1
2
4
Kilometers
130°4'W
130°3'W
130°2'W
130°1'W
130°W
129°59'W
129°58'W
46°1'N
46°N
45°59'N
45°58'N
45°57'N
45°56'N

6.3.6 J2-826


J2-826 North Rift Zone
130°W
129°59'30"W
129°59'W
46°6'N
46°5'30"N
46°5'N
46°4'30"N
Waypoints
Samples
Markers
J826 navigation
2015 lava boundary
Bathymetry
meters
High : -1675
Low : -1775
WP12
Geo-20
WP11
HFS-17; major-18; Geo-19
WP10
Geo-16
WP8
Geo-15
WP7
Geo-14
WP6
Geo-13
WP9
Mkr261
Snowdrift
WP5
Bio-09; HFS-(10,11); GTB-12
Geo-08
0
250
500
1,000
Meters
Mkr294
WP4
HFS-(01-07)

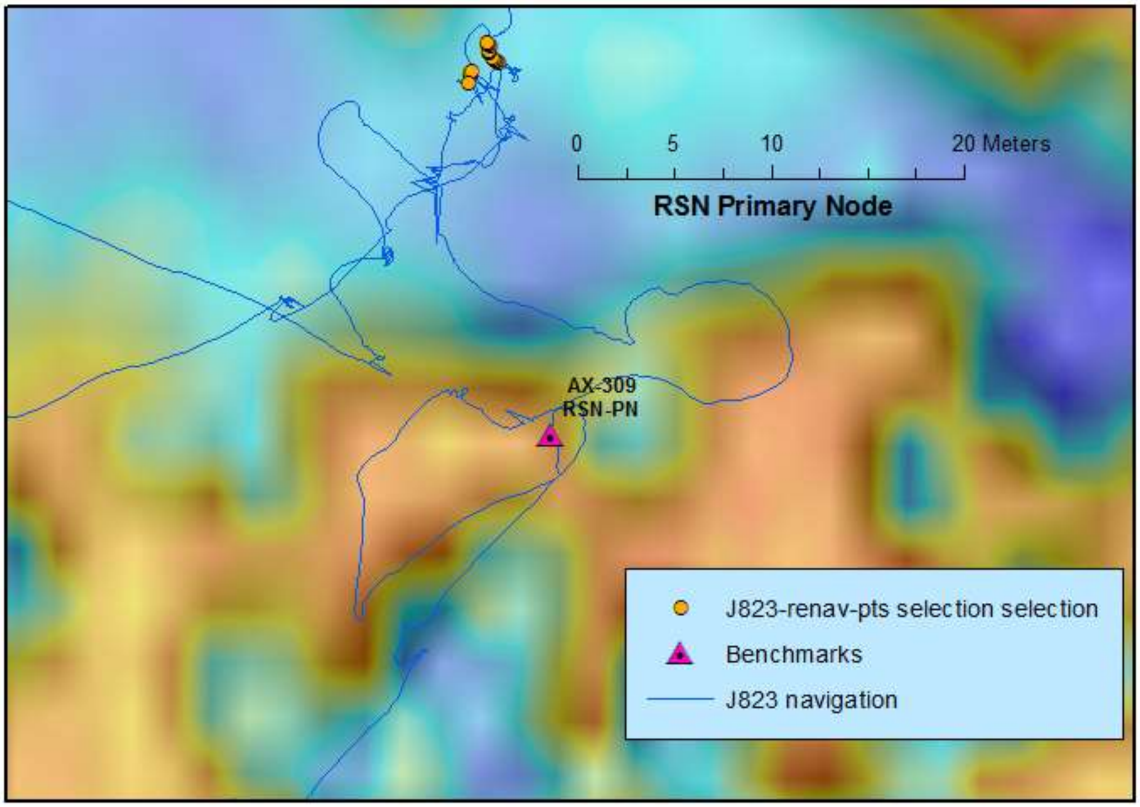
6.4 Navigation (Markers)

Navigation positions for 2015 Jason dives were slightly more offset than observed during the 2013 dives at Axial. Offset distances ranged from 5 meters up to 20 meters with most offsets over 10 meters compared to offsets of 5 meters of less in 2013. Positions were generally to the NW compared to historic positions. Jason navigators noted the offsets in Table 6.4-1 for various locations on a number of dives. Post-dive maps indicate these logged offsets were consistent with other navigational offsets to previously visited seafloor locations. Figure 6.4-1 shows the offsets for the RSN Primary Node benchmark which had the largest offset noted between two visits. The figure also includes offsets at the International District observed while sampling 3 vents as well as the navigator logged offset while conducting the pressure measurement at the nearby benchmark. The underlying MBARI bathymetric grid was consistent with the 2015 navigation for the RSN-PN site as the benchmark is located in a collapsed area. The historic position for AX-309 plots on top of a uncollapsed pillar/bridge area. Future analysis of the 2015 navigation and bathymetry may necessitate updating positions for various benchmarks, markers and vents to reduce dive time spent looking for historic sites.

Table 6.4-1 Navigation offsets noted by Jason navigator during dives and logged into the Virtual Van.

Location	Dive	Offset (meters)	Bearing (degrees)	Notes
AX-309	J823	14	340	1st pressure measurement
AX-309	J823	20	340	2nd pressure measurement
AX-310	J823	8	310	pressure measurement
AX-105	J823	12	280	pressure measurement
AX-302	J823	5	340	pressure measurement
Diva	J822	14	260	sampling
Mkr113 vent	J824	14	279	sampling
Vixen	J824	10	300	sampling

Figure 6.4-1 Maps showing navigational offsets at the RSN Primary Node site and International District. 2015 navigation was offset to the NW and ranged over 10 meters from historic positions of the vents and benchmarks see Table 6.4-1.



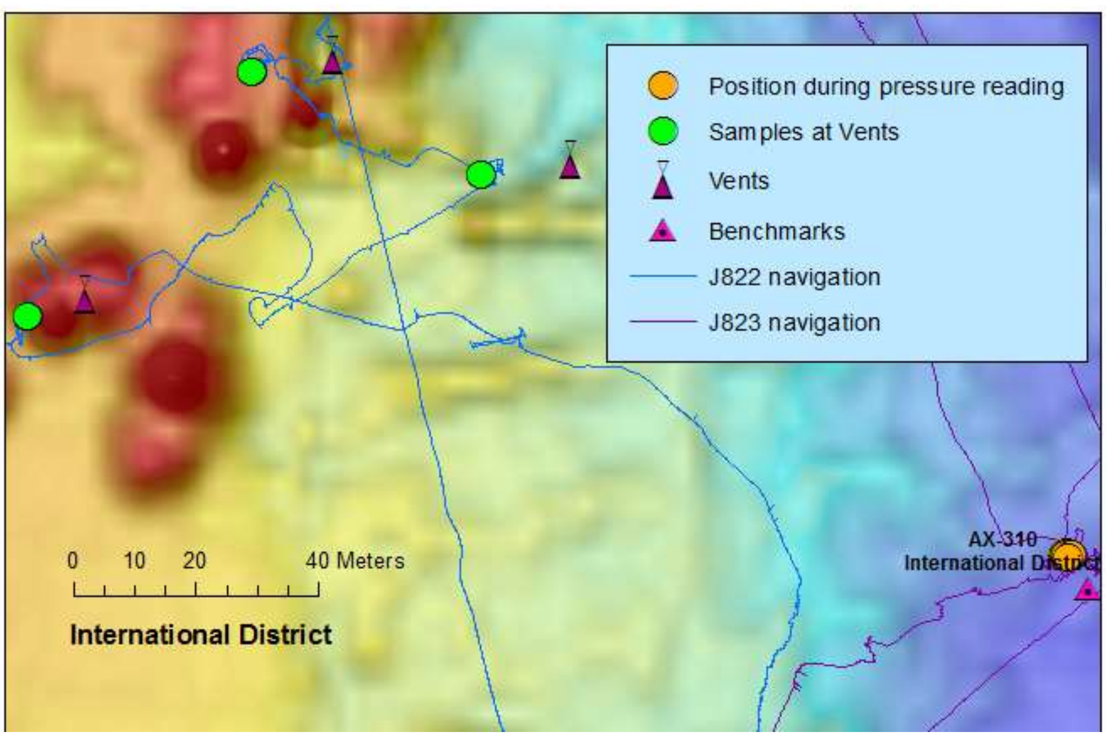


Table 6.4-2 Markers deployed and viewed in 2015. Markers in italics were deployed in 2015 by Jason on TN327 and by ROPOS on TN326 Markers in bold were seen during the TN327 dives, the few that are not were specifically mentioned in the log were at benchmarks or were the UW expedition markers at the NRZ. Positions for pre-2015 deployed markers have not been corrected for any offsets observed in 2015.

Marker	Latitude	Longitude	Z	Location	Vent	Deployed	Benchmark	comments
AX-105	45.86317	-130.00375	1723	South Pillow Mound			AX-105	Cement benchmark AX-105 at S. Pillow Mound site
AX-106	45.93445	-130.01160	1542	ASHES		J2-522	AX-106	Cement benchmark AX-106 is ~150 m ENE of ASHES
Mkr63	45.94639	-129.98382	1520	2011 Lava Flow	Trevi benchmark		AX202	Attached to metal tripod benchmark that was moved from caldera center to near Trevi vent in 2011. Seen 2015.
Mkr66	45.93342	-129.98228	1516	2011 Lava Flow	near Marker 33 Vent		AX203	Attached to metal tripod benchmark that was moved from near AX105 to near Marker33 vent in 2011. Seen 2015.
Mkr136	45.94642	-129.98379	1522	2011 Lava Flow		J730	AX-302	Mrk63 is on old benchmark AX-202 also at this AX-302 site (metal triangle). VV#8714. Seen 2015.
Mkr127	45.94533	-130.00913	1545	West of Magnesia		J730	AX-307	Cursor position at AX-307 and Mkr127. Seen 2015.
Mkr130	45.93846	-129.97209	1527	RSN PN		J730	AX-309	At RSN Primary Node site and AX-309. Cursor position. VV#7712. Seen 2015.
Mkr126	45.92580	-129.97787	1531	International District		J730	AX-310	Using cursor position for location. AX-310 site. VV#7452
Mkr166	45.93316	-129.98228	1520	2011 Lava Flow	Marker33 Vent			Deployed after 2011 flow. Seen 2013 & 2015.
Mkr121	45.93355	-130.01325	1542	ASHES	Gollum	J2-521		Seen 2015.
Mkr129	45.93327	-130.01374	1542	ASHES	Anemone	J726		Using 2013 sampling/MTR3004 cursor lat/long. VV#1045
Mkr31	45.93363	-130.01358	1547	ASHES	Mushroom			Deployed 1986 by Pisces IV. Using 2007 vent position.
Mkr47	45.93345	-130.01349	1542	ASHES	between Gollum-Dave's			Seen 2015 J2-824.
Mkr64	45.93356	-130.01330	1545	ASHES	Gollum	J2-293		Seen 2015.
Mkr122	45.91717	-129.99290	1534	Coquille	Diffuse vent area	J2-520		Seen 2015.

Marker	Latitude	Longitude	Z	Location	Vent	Deployed	Benchmark	comments
Mkr150	45.92642	-129.97898	1520	International District	Diva			Seen 2015.
Mkr153	45.92650	-129.97920	1517	International District	9m Chimney			Seen 2015.
Mkr-246	*45.97808*	*-130.01242*	*1570*	*NE Caldera*		*J822*		*At J822-geo-24 sample site near WP5.*
Mkr-275	*45.97808*	*-130.01242*	*1570*	*NRZ*		*J822*		*At J822-geo-24 sample site near WP5.*
Mkr240	*45.98298*	*-130.01111*	*1579*	*NRZ*		*J822*		*At J822-geo-25 sample site between WP6-WP7 (ROV weight management)*
Mkr242	*45.98298*	*-130.01111*	*1579*	*NRZ*		*J822*		*At J822-geo-25 sample site between WP6-WP7 (ROV weight management)*
Mkr260	*45.98298*	*-130.01111*	*1579*	*NRZ*		*J822*		*At J822-geo-25 sample site between WP6-WP7 (ROV weight management)*
Mkr294	*46.07469*	*-129.99505*	*1716*	*NRZ*		*J826*		*RAS location on NRZ. Sampled on J820 and J826.*
Mkr-K	*46.11133*	*-129.97217*	*1752*	*NRZ*		*R1863*		*Marks venting area on top of the North Rift Zone 2015 lava flow (TN326/ROPOS)*
Mkr-UW	*46.11476*	*-129.96307*	*1756*	*NRZ*		*R1863*		*Marks venting area on top of the North Rift Zone 2015 lava flow (TN326/ROPOS)*
Mkr261	*46.08035*	*-129.99235*	*1727*	*NRZ*		*J826*		*NRZ Snowdrift. Thick eruptive (orange-white) mat on way to WP5 in 2015 on new lava. Area of big collapse. Sampled in cracks with intense flow. MTR 4127 deployed at site.*

6.5 JASON Samples

97 total samples were collected by JASON on this expedition. The samples were composed of 60 fluid, 9 gas, 1 biology and 27 geology samples. Dive maps show the collection locations for each dive.

Table 6.5.1 Samples

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J2-820 Samples											
J820-Geo-01	geo	NRZ	Southern end of main eruption on NRZ. Close to eruptive fissure - West side.	Angular basaltic lava rind broken from drained pillow. Probably 2015.	Paduan	8/17/15 8:34	46.06472	-130.00023	1701	274	48
J820-Geo-02	geo	NRZ	East side of the eruptive fissure. Less eruptive mat.	3 pieces of basaltic lava. Thin rectangular large glassy rind from 2015 flow drained lobate.	Paduan	8/17/15 9:47	46.06720	-129.99929	1705	74	158
J820-Geo-03	geo	NRZ	Lavas with yellow-ish eruptive mat coating	3 separate grabs from same jumbled sheet flow on pressure ridge. Basaltic 2015 flow.	Paduan	8/17/15 11:15	46.07195	-129.99773	1722	359	324
J820-Major-04	fluid	NRZ	Area of yellowish intermittent mat and diffuse flow from small crack in drain-out surface.	White major water sample Tmax=20.9C in diffuse flow.	Butterfield	8/17/15 11:30	46.07219	-129.99768	1723	346	356
J820-GTB-05	gas	NRZ		Silver #11 GTB at same location as major-04. Tmax=20.9C in diffuse flow.	Lupton	8/17/15 11:34	46.07219	-129.99768	1723	346	361
J820-Major-06	fluid	NRZ	Top of mound between pillows covered in white bacterial mat in diffuse flow.	Red major #22. Tmax=19.6C in diffuse flow.	Butterfield	8/17/15 12:27	46.07480	-129.99520	1717	310	498
J820-GTB-07	gas	NRZ		White gtb #17. Tmax=19.6C in diffuse flow. Same position as major-06.	Lupton	8/17/15 12:34	46.07480	-129.99520	1717	307	515

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J820-Geo-08	geo	NRZ	On top of mound that is mainly lobate with some pillows. White bacterial mat and eruptive mat covers pillows	Large basaltic pillow bud from 2015 flow. Covered in eruptive mat.	Paduan	8/17/15 12:41	46.07491	-129.99511	1717	48	530
J2-822 Samples											
J822-HFS-01	fluid	Mkr-33 Vent site	Small tubeworm bush with (skinny stalks and red plumes0 good flow and some white floc coming out of flow.	inc #1. Start 0126.Tmax=32.3C Tavg=28.3C.. Vol=1250ml. Closed at 0202. 18 hours on seafloor.	Butterfield	8/21/15 1:26	45.93325	-129.98236	1517	244	893
J822-HFS-02	fluid	Mkr-33 Vent site		inc #2. Start 0135. Tmax=34.8 Tavg=33.4. Vol=1250ml. Closed at 0204. 18 hours on seafloor.	Butterfield	8/21/15 1:35	45.93325	-129.98236	1517	244	907
J822-HFS-03	fluid	Mkr-33 Vent site		Inc #3. Stop 0142. Tmax=35.3 Tavg=33.9. Vol=1250ml. Closed 0205. 12 hours on seafloor.	Butterfield	8/21/15 1:45	45.93325	-129.98236	1517	244	918
J822-HFS-04	fluid	Mkr-33 Vent site		Inc #4. Stop 0201. Tmax=33.6 Tavg=33.1C. Vol=1250ml. Closed 0206. 12 hours on seafloor.	Butterfield	8/21/15 1:54	45.93325	-129.98236	1517	244	928
J822-HFS-05	fluid	Mkr-33 Vent site		Large volume bag #1 (lvb) No filters on the lvbs. Stop 0230. Vol=4000ml Tmax=33.7 Tavg=33.1 T2=14.	Butterfield	8/21/15 2:09	45.93325	-129.98236	1517	244	954
J822-HFS-06	fluid	Mkr-33 Vent site		Unfiltered bag #7. Stop 0236. Tmax=33.2 Tavg=33.0 Vol=650ml. T2=14.	Butterfield	8/21/15 2:32	45.93325	-129.98236	1517	244	974
J822-HFS-07	fluid	Mkr-33 Vent site		Unfiltered bag #8. Stop 0241. Tmax=34.6 Tavg=34.0 T2=15. Vol=650ml.	Butterfield	8/21/15 2:37	45.93325	-129.98236	1517	244	978
J822-HFS-08	fluid	Mkr-33 Vent site		Unfiltered bag #9. Stop 0246.Tmax=35.7 Tavg=35.5 T2=15. Vol=-650. O2=0.202 reading	Butterfield	8/21/15 2:42	45.93325	-129.98236	1517	244	983

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J822-HFS-09	fluid	Mkr-33 Vent site		RNA #11 start. Stop 0309. Tmax=35.1 Tavg=34.3 T2=14. Vol=3001ml.	Huber Holden	8/21/15 2:53	45.93325	-129.98236	1517	244	995
J822-HFS-10	fluid	Mkr-33 Vent site		RNA #10. Stop 0328. Tmax=36.5 Tavg=35.6 T2=15 Vol=3000ml.	Huber Holden	8/21/15 3:11	45.93325	-129.98236	1517	244	1009
J822-GTB-11	gas	El Guapo	15m high sulfide chimney. Int'l Dist. High flow; not boiling	Gastight (orange-black #7) from the top of chimney. Tmax=323C. Sample ~2 in. into chimney top.	Lupton	8/21/15 5:23	45.92655	-129.97965	1502	96	1238
J822-major-12	fluid	El Guapo		Major sampler red-yellow #22 placed into the same hole as sample 11 but there is less chimney because a small portion broke off during previous sample.	Butterfield	8/21/15 5:23	45.92655	-129.97965	1502	96	1247
J822-HFS-13	fluid	El Guapo		Unfiltered piston #2. Stop 1540. Tmax=317.1 Tavg=no good T2=100 Vol=550ml.	Butterfield	8/21/15 5:37	45.92655	-129.97965	1502	96	1281
J822-HFS-14	fluid	El Guapo		Filtered piston #3. Stop 0545. Tmax=318.8 Tavg-no good T2=100 Vol=550. Pump got too hot during sampling.	Butterfield	8/21/15 5:42	45.92655	-129.97965	1502	96	1291
J822-GTB-15	gas	Diva	In high flow at top of anhydrite mound	Gastight yellow #11 in the top of the anhydrite mound where the Jason probe measured 279C.	Lupton	8/21/15 6:09	45.92640	-129.97916	1519	110	1339
J822-HFS-16	fluid	Diva		Filtered piston #5. Stop 0617. Tmax=275.2 Tavg=274.8 T2=85 Vol=210ml.	Butterfield	8/21/15 6:15	45.92640	-129.97916	1519	110	1350
J822-HFS-17	fluid	Diva		Unfiltered piston #6. Start 0617. Tmax=275.4 Tavg=275.3 T2=88 Vol=250ml.	Butterfield	8/21/15 6:17	45.92640	-129.97916	1519	110	1355
J822-HFS-18	fluid	Castle	Tall sulfide chimney with anhydrite vent. JasonT=273.9C	Piston #4 (filtered or unfiltered?). Stop 0718. Tmax=251.5 T2=77.6; Tavg=250.8 Vol=253 ml. In anhydrite vent.	Butterfield	8/21/15 7:17	45.92618	-129.98012	1519	319	1430

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J822-GTB-19	gas	Castle		Red gas-tight #9. In anhydrite vent.	Lupton	8/21/15 7:17	45.92618	-129.98012	1519	319	1438
J822-geo-20	geo	NE Cald	2015 lava flow	2 small pieces of same pillow bud. Glass exterior. At southern contact (WP1 area). Thin flow here.	Paduan	8/21/15 10:58	45.95601	-129.99401	1529	64	1509
J822-geo-21	geo	NE Cald	2015 lava flow	Edge of collapse in this lobate flow. Grabbing collapse shelf with shiny glass surface. 2 small pieces of collapse shelf.	Paduan	8/21/15 12:17	45.96294	-129.99623	1525	19	1662
J822-geo-22	geo	NE Cald	2015 lava flow	Piece of the roof shelf. It's a large piece. Broke it. Shiny glass surface of this roof feature. (S of WP3)	Paduan	8/21/15 13:28	45.96803	-130.00091	1540	324	1807
J822-geo-23	geo	NE Cald	2015 lava flow next to mat.	Intact pillow-esque piece of lava but only the crust broke off. Some glass.	Paduan	8/21/15 14:54	45.97396	-130.00256	1542	342	1961
J822-geo-24	geo	NE Cald	2015 lava flow in eruptive mat. (Mkrs 246 & 275)	Pre-broken rubbly lava bits in sedimented flow. (At WP5)	Paduan	8/21/15 17:47	45.97808	-130.01242	1570	30	2219
J822-geo-25	geo	NE Cald	2015 lava flow along contact	Lava sample in area where there may be 3 generations of lavas. Darkest looking lava.	Paduan	8/21/15 19:12	45.98298	-130.01111	1579	51	2327
J822-Major-26	fluid	T&S Spires	CASM Sulfide chimney	White major sample in active sulfide chimney covered in dense tubeworms and tons of other biota.	Butterfield	8/21/15 21:30	45.98921	-130.02719	1572	344	2435
J2-823 Samples											
J823-geo-01	geo	AX-101	Caldera center benchmark	Suction sample of particles on the AX-101 benchmark (concentrated on the rim) - probably volcanic ash from the 2015 eruption. Sample added to on second visit of pressure readings.	Paduan	8/23/2015 07:15; 22:02	45.95525	-130.01003	1532	240	3053; 3496

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J823-geo-02	geo	AX-309	Near the RSN primary node.	Rock sample at AX-309. Location is due S of the benchmark a few meters. Collected from pile at collapse face on sheet flow - for ballast. Old lava (not 2015 flow).	Paduan	8/24/15 3:48	45.93835	-129.97200	1526	213	3620
J2-824 Samples											
J824-HFS-01	fluid	Inferno	Near the top at the base of a small beehive.	Unfiltered piston #2. Tmax=230.4 Tavg=222C T2=80 Vol=700ml Stop= 2154.	Butterfield	8/24/15 21:49	45.93352	-130.01379	1538	149	4025
J824-HFS-02	fluid	Inferno		Unfiltered Bag #24. Tmax=225.4C Tavg=209C T2=70C Vol=550ml. Stop 2158.	Butterfield	8/24/15 21:54	45.93352	-130.01379	1538	149	4029
J824-Major-03	fluid	Inferno		White Major; Fired: 22:06. Same location. Tmax=244.4C Jason Tmax=220C.	Butterfield	8/24/15 21:49	45.93352	-130.01379	1538	148	4037
J824-HFS-04	fluid	Virgin	Jason Tmax=258C In anhydrite orifice after knocked over. Vigorous flow.	Filtered piston #3. Stop 2256. Tmax=200.5C Tavg=194C Vol=400ml. T2=76C.	Butterfield	8/24/15 22:54	45.93366	-130.01334	1541	90	4097
J824-HFS-05	fluid	Virgin		Unfiltered piston #4. Start 2257. Virgin vent. Stop 2300. Tmax=198C Tavg=196C Vol=400ml T2=77C.	Butterfield	8/24/15 22:57	45.93366	-130.01334	1541	90	4102
J824-GTB-06	gas	Virgin		Gastight Black #18. Tmax with the beast was 200.5C. With Jason was 258C.	Lupton	8/24/15 23:04	45.93366	-130.01334	1541	89	4112
J824-HFS-07	fluid	Anemone	In tubeworms and other dense biota near the base of the MTR. Temp varies. HFS O2=0.467ml/L.	Unfiltered bag #22. Stop 2347. Tmax=20.5C Tavg=19.7C Vol=938ml. T2=10C.	Butterfield	8/24/15 23:42	45.93318	-130.01387	1541	178	4211
J824-HFS-08	fluid	Anemone		Filtered bag #21. Stop 2352. Tmax=20.4C Tavg=17.9C Vol=755ml T2=8.5C.	Butterfield	8/24/15 23:48	45.93318	-130.01387	1541	178	4221

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J824-HFS-09	fluid	Anemone		RNA filter #10. This will be 4500ml. Stop 0011. Tmax=19.6C Tavg=16.6C T2=8.5C Vol=3905ml.	Huber Holden	8/24/15 23:53	45.93318	-130.01387	1541	178	4236
J824-HFS-10	fluid	Trevi	Anhydrite mound (no chimney here this year). JasonT=240.5C.	Filtered piston #5. Tmax=241.2C Tavg=241.0C Vol=403ml T2=~70C.	Butterfield	8/25/15 8:54	45.94620	-129.98376	1518	201	4667
J824-HFS-11	fluid	Trevi		Unfiltered piston #8. Tmax=241.2C Tavg=241.1C Vol=451ml T2=~72C.	Butterfield	8/25/15 8:57	45.94620	-129.98376	1518	201	4671
J824-GTB-12	gas	Trevi		Green gastight. HFS Tmax for samples was 241.2C.	Lupton	8/25/15 9:04	45.94620	-129.98376	1518	201	4679
J824-HFS-13	fluid	Mkr 113 vent	In diffuse flow <1m from collapse edge in crack with dense biota - mainly limpets but some tubeworms and palmworms. O2=0.178 at 25C. JasonT=21.7.	Large volume bag (lvb) #1. 1531 stop. Tmax=25.5C Tavg=25.4C Vol=5000ml T2=5.6C.	Butterfield	8/25/15 15:08	45.92277	-129.98829	1520	322	4908
J824-HFS-14	fluid	Mkr 113 vent		Filtered Bag#17. Stop 1540. Tmax=25.2C Tavg=25.2C Vol=750ml T2=5.7C.	Butterfield	8/25/15 15:33	45.92277	-129.98829	1520	323	4939
J824-HFS-15	fluid	Mkr 113 vent		Unfiltered Bag #18. Stop 1544. Tmax=25.2C Tavg=25.1C Vol=900ml T2=6.4C.	Butterfield	8/25/15 15:40	45.92277	-129.98829	1520	324	4947
J824-HFS-16	fluid	Mkr 113 vent		RNA filter #11. Stop 1608. Tmax=25.3C Tavg=25.3C Vol=4500ml T2=6.4C.	Huber Holden	8/25/15 15:46	45.92277	-129.98829	1520	324	4956
J824-HFS-17	fluid	Mkr 113 vent	In diffuse flow <1m from collapse edge in crack with dense biota - mainly limpets but some tubeworms and palmworms. O2=.145ml/l at 25.5C stabilized.	RNA filter #13. Stop 1624. Tmax=25.4C Tavg=25.3C Vol=3500ml T2=6.7C.	Butterfield	8/25/15 16:08	45.92277	-129.98829	1520	324	4990

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J824-HFS-18	fluid	Mkr 113 vent	In diffuse flow <1m from collapse edge in crack with dense biota - mainly limpets but some tubeworms and palmworms.	Filtered Bag #19. Stop 1634. Tmax=25.5C Tavg=25.4C Vol=750ml T2=6.4C.	Butterfield	8/25/15 16:31	45.92277	-129.98829	1520	323	5011
J824-HFS-19	fluid	Mkr 113 vent		Ambient vent-area fluid ~1m above the vent. LVB #16. Stop 1646. Tmax=3.1C Tavg=2.9C Vol=1970ml T2=2.5C.	Butterfield	8/25/15 16:37	45.92277	-129.98829	1520	322	5026
J824-HFS-20	fluid	Mkr 113 vent	In diffuse flow <1m from collapse edge in crack with dense biota - mainly limpets but some tubeworms and palmworms - sample ended as Jason left vent site.	Ambient vent-area fluid. HFS wand tip in port forward compartment on the basket. RNA Filter #14. Stop 1711. Tmax=3.2C Tavg=2.6C Vol=4660ml T2=2.5C.	Huber Murdock	8/25/15 16:47	45.92277	-129.98829	1520	323	5036
J824-GTB-21	gas	Vixen	Anhydrite mound with small grayish-black chimney. Intense flow. Knocked over for sampling. JasonT=326.4C.	Green/Red gastight bottle.	Lupton	8/25/15 18:16	45.91739	-129.99308	1533	211	5223
J824-HFS-22	fluid	Vixen		Unfiltered piston #6. Stop 1623.Tmax=324.6C Tavg=321.1C T2=100C Vol=450ml.	Butterfield	8/25/15 18:21	45.91739	-129.99308	1533	210	5236
J824-HFS-23	fluid	Vixen		Filtered piston #9. Stop 1826. Tmax=325.7C Tavg=325.1C T2=92C Vol=450ml.	Butterfield	8/25/15 16:24	45.91739	-129.99308	1533	212	5245
J824-HFS-24	fluid	Casper	Anhydrite mound with larger grayish black chimney. Knocked over for sampling. Intense flow.	Filtered Piston #7. Stop 1901. Tmax=297.7C Tavg=297.4C Vol= 453ml T2= 93C.	Butterfield	8/25/15 18:59	45.91744	-129.99313	1532	88	5299

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J2-825 Samples											
J825-HFS-01	fluid	Mkr-33 Vent	Small tubeworm bush with (skinny stalks and red plumes0 good flow and some white floc coming out of flow. Same site as J2-822.	Inc #1. Valve position 13. Closed 1711. Tmax=40.6C Tavg=40.5C Vol=800ml T2=22C. (1810-1815 closed valves)	Butterfield	8/26/15 17:06	45.93316	-129.98222	1516	246	5520
J825-HFS-02	fluid	Mkr-33 Vent		Inc #2. Valve position 15. Closed 1716. Tmax=40.5C Tavg=40.4C T2=23C Vol=850ml. (1810-1815 closed valves)	Butterfield	8/26/15 17:13	45.93316	-129.98222	1516	246	5530
J825-HFS-03	fluid	Mkr-33 Vent		Inc #3. Valve position 17. Closed 1722. Tmax=40.4C Tavg=40.4C Vol=850ml T2=22C. (1810-1815 closed valves)	Butterfield	8/26/15 17:18	45.93316	-129.98222	1516	246	5542
J825-HFS-04	fluid	Mkr-33 Vent		Inc #4 Valve position 19. Closed 1727. Tmax=40.5C Tavg=40.3C T2=22C Vol=850ml. (1810-1815 closed valves)	Butterfield	8/26/15 17:23	45.93316	-129.98222	1516	246	5547
J825-HFS-05	fluid	Mkr-33 Vent		Filtered bag #9. Stop 1736. Tmax=40.6C Tavg=40.C5 T2=22C Vol=750ml. Large floc explosion during this sample.	Butterfield	8/26/15 17:30	45.93316	-129.98222	1516	245	5557
J825-HFS-06	fluid	Mkr-33 Vent		LVB #1. Stop 1755. Tmax=40.7C Tavg=40.6C T2=22.7C Vol=4000ml.	Butterfield	8/26/15 17:38	45.93316	-129.98222	1516	245	5583
J825-HFS-07	fluid	Mkr-33 Vent		Unfiltered bag #8. Tmax=40.4C Tavg=40.3C vol=800ml T2=21C.	Butterfield	8/26/15 18:33	45.93316	-129.98222	1516	249	5637
J825-HFS-08	fluid	Mkr-33 Vent		Unfiltered bag #7. Stop 1842. Tmax=40.6C Tavg=4 0.4C Vol=800ml T2=21C.	Butterfield	8/26/15 18:38	45.93316	-129.98222	1516	249	5644
J825-HFS-09	fluid	Mkr-33 Vent		RNA filter #10. Stop 1908. Tmax=40.9C Tavg=40.7C Vol=4002ml T2=21C.	Huber Holden	8/26/15 18:43	45.93316	-129.98222	1516	249	5651

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J825-Geo-10	geo	NRZ	Contact. Lava is glossy black with thick white deposit under glass on broken surface.	Chunk of 2015 lava from contact in an old fissure. Broken from rind of hollow pillow.	Paduan	8/27/15 7:30	46.00437	-130.01121	1534	4	6117
J825-Geo-11	geo	NRZ	Sheet flow @WP10.	Small chunk mostly glass from sheet flow in 2015 lava.	Paduan	8/27/15 8:06	46.00760	-130.01016	1550	351	6187
J825-Geo-12	geo	NRZ	Pillars and roof collapse area	2015 lava piece with large glassy rind broken from roof of collapse.	Paduan	8/27/15 8:23	46.00865	-130.00976	1556	11	6209
J825-Geo-13	geo	NRZ	Near contact	Pillow bud from 2015 lava near contact in area of thin flow.	Paduan	8/27/15 8:44	46.00938	-130.00928	1558	203	6244
J825-Geo-14	geo	NRZ	Just W of WP11	Piece of 2015 lava broken from jumbled sheet flow.	Paduan	8/27/15 8:55	46.01066	-130.00909	1567	309	6262
J825-Geo-15	geo	NRZ	Inflated cracked lobate surface	Piece of 2015 lava broken from inflated lobate flow.	Paduan	8/27/15 9:10	46.01157	-130.01009	1574	314	6287
J825-Geo-16	geo	NRZ	Inflated lobate flow near WP12	Piece of 2015 lava broken from bulbous pillow.	Paduan	8/27/15 9:26	46.01232	-130.01217	1578	329	6309
J825-Geo-17	geo	NRZ	Near contact with small sponges on old lava. Near WP13.	Enormous pillow bud from 2015 flow near contact.	Paduan	8/17/15 9:52	46.01346	-130.01493	1582	278	6346
J2-826 Samples											
J826-HFS-01	fluid	Mkr-294 on NRZ	NRZ lobate and pillow lava. Diffuse flow with eruptive mat. RAS. (sampled on J820). O2=0.522ml/L	Unfiltered Bag #18. Stop 2140 Tmax=19.9C Tavg=18.9C Vol=600ml T2=3C	Butterfield	8/27/15 21:37	46.07469	-129.99505	1716	296	6460
J826-HFS-02	fluid	Mkr-294 on NRZ		Filtered (?) Bag #19. Stop 2145. Tmax=20.0C Tavg=19.1C Vol=600ml T2=3C.	Butterfield	8/27/15 21:41	46.07469	-129.99505	1716	296	6465
J826-HFS-03	fluid	Mkr-294 on NRZ		Unfiltered Bag #20. Stop 2150. Tmax=19.7C Tavg=19.1C Vol=600ml T2=3C.	Butterfield	8/27/15 21:46	46.07469	-129.99505	1716	296	6474
J826-HFS-04	fluid	Mkr-294 on NRZ		Piston #7 Stop 2157. Tmax=20.0 Tavg=19.3 Vol=600ml T2=3.0.	Butterfield	8/27/15 21:54	46.07469	-129.99505	1716	296	6480

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J826-HFS-05	fluid	Mkr-294 on NRZ		Unfiltered Piston #8. Stop 2202. Tmax=19.0C Tavg=18.2C Vol=600ml T2=3.1C.	Butterfield	8/27/15 21:59	46.07469	-129.99505	1716	296	6481
J826-HFS-06	fluid	Mkr-294 on NRZ		Unfiltered Piston #6. Stop 2206. Tmax=19.5 Tavg=18.9 Vol=600ml T2=3.0.	Butterfield	8/27/15 22:03	46.07469	-129.99505	1716	296	6484
J826-HFS-07	fluid	Mkr-294 on NRZ		RNA filter #14. Stop 2229. Tmax=19.8C Tavg=17.9C Vol=3029ml T2=3.0C.	Huber Holden	8/27/15 22:08	46.07469	-129.99505	1716	296	6493
J826-Geo-08	geo	NRZ. Near WP5.	Area of lava pillars and roof features at edge of collapse. Thick eruptive mat in area.	A piece of pillar roof in the 2015 flow. Orange staining on the roof and some eruptive mat.	Paduan	8/28/15 0:10	46.08011	-129.99241	1729	306	6689
J826-Bio-09	bio	NRZ. Snowdrift Mkr-261	Area of thick eruptive mat and diffuse flow - 2015 lava flow.	Suction sample of fluffy orangish "eruptive" bacterial mat - and probably some volcanic glass too.	Holden	8/28/15 0:22	46.08035	-129.99235	1729	359	6715
J826-HFS-10	fluid	NRZ. Snowdrift Mkr-261		Unfiltered piston #2. Stop 0036. Tmax=35.4C Tavg=35.3C Vol=600ml T2=7.4C.	Butterfield	8/28/15 0:33	46.08035	-129.99235	1727	358	6747
J826-HFS-11	fluid	NRZ. Snowdrift Mkr-261		Filtered piston #3. Stop 0041. Tmax=35.4C Tavg=35.2C Vol=600ml. T2=7.4C.	Butterfield	8/28/15 0:37	46.08035	-129.99235	1727	358	6754
J826-GTB-12	gas	NRZ. Snowdrift Mkr-261		Gastight (green-yellow?) in the same orifice as the last 2 samples. Tmax was 35.4C.	Lupton	8/28/15 0:45	46.08035	-129.99235	1727	358	6764
J826-Geo-13	geo	NRZ. 400m S of WP6	Area of lobate and pillow lavas. Not much mat.	Piece of rind from hollow pillow - 2015 flow.	Paduan	8/28/15 1:48	46.08441	-129.98894	1722	70	6877
J826-Geo-14	geo	NRZ. 25m SSE of WP7	Area of broad lobates with pillows here and there.	Piece of pre-broken hollowed out pillow rind - from the 2015 flow.	Paduan	8/28/15 2:31	46.08789	-129.98733	1724	25	6961

Sample	Type	Site	Site Description	Sample Description	Contact	Date Time	latitude	longitude	Depth	Heading	Virtual Van #
J826-Geo-15	geo	NRZ. Near WP8	Area of pillows with bacterial staining at their bases.	From the base of large pillow with orange coating - from the 2015 flow.	Paduan	8/28/15 3:15	46.09066	-129.98615	1738	346	7034
J826-Geo-16	geo	NRZ. SSE of WP10	Area of lobates and pillow buds.	Small round pillow lava bud with some mat from the base of a larger pillow - from the 2015 flow.	Paduan	8/28/15 3:52	46.09376	-129.98879	1749	325	7127
J826-HFS-17	fluid	NRZ. Between WP10 and WP11	Area of pillow lavas with lots of white flock emitting from a crack with shimmering water. O2=.98ml/L	Unfiltered piston #4. Stop 0449. Tmax=5.6C Tavg=5.3C T2=2.2CVol=602ml.	Butterfield	8/28/15 4:45	46.09467	-129.98857	1745	54	7248
J826-Major-18	fluid	NRZ. Between WP10 and WP11		Red major fluid sample at the same location. Tmax was 5.6C.	Butterfield	8/28/15 4:51	46.09467	-129.98857	1745	54	7257
J826-Geo-19	geo	NRZ. Between WP10 and WP11		Small piece of pillow lava with lots of glass (mat-covered)- taken next to the fluid sampling site.	Paduan	8/28/15 4:58	46.09467	-129.98857	1745	45	7279
J826-Geo-20	geo	NRZ. ~150m S of WP12	Black lobate flow.	Piece of lobate bud with some of the glass peeled off but much remains intact. Position is approx.	Paduan	8/28/15 5:43	46.09856	-129.98666	1771	233	7367

6.5 JASON Dive logs

This version of the cruise report does not contain the dive logs. The full-version (with logs) can be found at:

http://www.pmel.noaa.gov/eoi/pdfs/Axial2015-Cruise-Report-with-logs.pdf

This shorter version is also available online at:

http://www.pmel.noaa.gov/eoi/pdfs/Axial2015-Cruise-Report-no-logs.pdf