Cruise Report: FK160407

East Lau Spreading Center and Valu Fa Ridge
Kingdom of Tonga

Research Vessel Falkor
ROV ROPOS
Schmidt Ocean Institute
US National Science Foundation*
April 7, 2016 – May 5, 2016-04-29

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Executive Summary

Our overarching goals of this expedition were to significantly increase our understanding of the physiological ecology of Lau Basin fauna and the processes that govern the ecological patterns observed in vent ecosystems, and to effectively communicate our findings to a broad audience. We used state-of-the-art equipment and analyses to characterize the physico-chemical environment, conduct laboratory experiments on deep sea animals under similar conditions to those found *in situ*, conduct manipulative experiments on the sea floor, obtain time series observations of natural changes in the communities, and make collections to examine connectivity among populations in the Lau Basin. Specifically we: 1) used the *ROV ROPOS* to conduct multibeam seafloor surveys to examine potential geological changes in each vent field; 2) revisited the community assessment sites we established in 2006 to acquire images for 2D and 3D photomosaics, and made spatially explicit *in situ* temperature and chemistry measurements to define the realized niches of the fauna and document natural changes in diffuse flow chemistry and the communities over time; 3) performed *in situ* manipulative experiments (flux integrator measurements coupled to quantitative collections) to quantify the impact of each major type of symbiosis on hydrothermal chemistry; 4) conducted shipboard respirometry experiments on live animals to determine the metabolic capacities of different host and symbiont combinations; and 5) made collections to analyze the genetic structure of the populations of key fauna in each vent field and assess connectivity among populations and potential barriers to dispersal.

Vessel, ROV, stereo camera and some technical assistance was supported by the Schmidt Ocean Institute. The scientists, some of the equipment, their logistics and data analysis and publication were supported through a collaborative grant from the US National Science Foundation to Penn State University, Harvard University, Woods Hole Institution, and Colombia University. At sea activities and collections were carried out with the approval of His Majesty's Cabinet of the Kingdom of Tonga (TN-085-2015 and diplomatic note from the Ministry of Foreign Affairs and Trade of the Kingdom of Tonga F.7/2/3).

This research expedition was divided into two legs. The first leg was led by chief scientist Peter Girguis, left from Suva Fiji on April 9, 2016 (2 days late due to weather) and ended in Nuku'alofa Tonga on April 18, 2016. The second leg was led by chief scientist Charles Fisher, left from Nuku'alofa Tonga on April 20 and ended in Suva Fiji on May 4 (one day early due to weather). On the whole, we completed about 80% of our initial proposals and plans. Notably, we were heavily impacted by adverse weather, especially during the first leg of the expedition,

which led to our completing 3 dives in 12 days at sea. Also, limitations on A-Frame loading meant that we were only able to make a single dive at our deepest study site (Tow Cam). We were not able to make a dive at our second deepest site (Kilo Moana). That said, we were able to make up for some of these shortcomings by visiting additional sites. for example, we made one dive at the Mariner vent field, a site not on our original cruise plan. This site proved to be quite relevant to our objectives as there was recent colonization by symbiont-containing vent fauna that were absent during our previous 2009 expedition . We also made dives to a new site named "Tahi Moana" (which means "one who lives by the deep sea"), which appears to have similar lava type to our deeper sites and should provide the needed comparison between Basalt and basaltic-Andesite based communities.

Despite the weather and other impediments, we were able to collect high resolution bathymetry from 4 key sites that can be compared to similar data collected in 2006, which will allow us to identify small- and larger scale changes at these sites from tectonic or volcanic activity. The new camera systems used during this study all functioned very well. Based on preliminary analyses of these high resolution 2D and 3D mosaics, the long-term study sites are much more stable than previously thought. This is a critical observation that is largely in contrast to our expectations, which was that these vent habitats are highly dynamic.

Our geochemical program also went extremely well. The ISMS (*in situ* mass spectrometer) performed very well after initial shake down dives. When coupled with the Flux Integrator (a new device built especially for this study), we were able to acquire high quality chemical measurements of flow ranging in temperature from a few degrees above ambient to over 300°C. High quality Isobaric Gas Tight (IGT) water collections were made from 3 sites and shipboard portion of those analyses successfully completed. Collections made in association with Flux Integrator measurements should provide some of the best data ever collected on the impact of these animal communities on the flux of chemicals from diffuse flow.

Numerous shipboard experiments were completed as planned, but results from these experiments must await shore-side analyses of the samples collected. However, our preliminary observations suggest that the metabolic activity of these animals is more diverse than previously thought. For example, we observed that the snail *Alviniconcha* and its symbionts may be able to live off of hydrogen gas (in addition to sulfide, as has been previously shown). Moreover, we conducted particle exposure experiments to assess the impact of natural and anthropogenic vent particles on the "health" of vent animals. The results of these latter studies will be informative as no such studies have been done to date. Finally, some of our ancillary projects were equally noteworthy, as they suggest that the snails may have a variety of sensory modes, including chemical sensing and possibly infrared detection, to find the warm waters they need to feed their symbionts.

Contents

Cruise summary
Note that dates and times are local: GMT +12 hrs.

Leg 1

April 5: Scientist Arrive to ship, safety briefings, orientations
April 6: Setting up for planned departure at 8 am on the 7th. Fuelling delayed. Went to anchor due to weather
April 7: Stayed at anchor Delayed due to Fuel dock/weather issues, ROPOS test dip
April 8: Bunkering Started taking on fuel from trucks in the afternoon
April 9: 0800 depart Suva
April 10: in transit.

1445 launch ROPOS for **Dive 1922 to ABE**

[Peter] We had the mass spec working, albeit modestly. We were able to take readings of a variety of diffuse flow temps at ABE, from ~15 to 150 C. This will be REALLY useful in extrapolating from the temp measurements at the long-term study sites to potential geochemical conditions. We did Eh/pH measurements in the "probe" configuration.

- [Cherisse] We competed mosaic, temperature, near-bottom multibeam surveys of ABE diffuse and peripheral sites (ABE1, ABE2, ABE1P, ABE2P). We also took 2 ISMS scans at each of the diffuse sites (ABE1, ABE2).
- Obstacles: Eh/Ph stopped working.
- [Monika] R1922-11: 3 tubeworm babies and various fauna from rock, meiofauna collection for Sabine
- [Roxanne] 1922-11: Collected and processed 40 Alviniconcha individuals for pop. gen.
- [Roxanne] Conducted HPRS experiment comparing Alviniconcha with epsilon and gamma-symbionts when exposed to hydrogen sulphide.
- [Arunima] Sub-sampled from Roxanne's samples, 20 individuals of *Alviniconcha* spp. for *in situ* tissue samples, and two individuals as controls for ship-based experiments.
- [Vicki] – acquired full near-bottom MB coverage of site at 20m altitude + opportunistic data during all down-looking mosaics (2m altitude).

April 12
1036 recover from ABE (44 hr dive)

Transit to Tu'i Malila

April 13:
1350 Launch **ROPOS dive 1923 on Tu'i Malila**
Dive aborted after 2 hrs
Problem with ROPOS DSC (seawater leak that ultimately blew out the pressure dome), recovered to fix problem (NOTE: the ROPOS team fixed the digital still camera by rinsing the components in seawater, then putting back in housing. It's still working but keep this in mind).
1550 Recover Ropos from Tu'I Malila

1643 Launch **ROPOS dive 1924 on Tu'I Malila**.

- [Peter] The ISMS was working a LOT better, and we did a lot of great work at Tui Mahlila. We did at least two ISMS runs at the TM1 diffuse long-term study site, as well as three or so measurements at the really close adjacent sites. We did Eh/pH measurements in the probe configuration. Note that, in the probe configuration, we may have been seeing a lot of mixing.
- [Cherisse] We completed mosaic surveys of TM diffuse and peripheral sites (TM1, TM2, TM1P, TM2P) with multibeam sonar turned on.
- [Monika] R1924-8: meiofauna collection for Sabine, R1924-11: bacterial collection from rock
- [Roxanne] Worked with Cherisse to make quick mosaic of diffuse flow area next to TM-1 (we have been calling this "TM-1 adjacent"). Used the mosaic to guide the collection of four Alviniconcha patches (1924-5,-7,-8,-10), with ISMS measurements taken post-collection. Subsampled 10 individuals per collection for Alviniconcha pop gen.
- [Roxanne] conducted HPRS experiment comparing Alviniconcha with high and low-density spike hairs, which may correspond to different Alviniconcha species, when exposed to hydrogen sulphide.
- [Arunima] Sub-sampled from Roxanne's samples, 20 individuals of *Alviniconcha* spp. and two *Ifremeria nautilei* for *in situ* tissue samples, and one individual *Alviniconcha* spp. as controls for ship-based experiments.
- [Vicki] – – acquired near-bottom MB coverage of most of site at 20m altitude + opportunistic data during all down-looking mosaics (2m altitude).

April 14

2120 Recover Ropos from Tu'I Malila (27.5 hr dive)

Waiting on Weather

April 15

1301 launch ROPOS **Dive 1925 on Tu'i Malila**

- Aborted after 4 hrs
- ISMS was not functional at seafloor, recovered to fix problem. The problem turned out to be a broken serial connector in the Control room, NOT the instrument. The problem has been repaired.

1730 recover ROPOS from Tu'i Malila

2035 Launch ROPOS **Dive 1926 @ Tu'i Malila**

- [Peter] We did a BUNCH of ISMS work on this dive. This was also the first dive for the flux integrator, which is working really well. We did at least two flux integrator/ISMS runs that worked great (i.e. it was clear that there was MORE sulfide in the water after we removed the Ifremeria). We did one flux integrator/ISMS run on an *Alviniconcha* patch, in which the data were a bit more confusing at first glance, but we are working on processing those data.
- [Peter] As for the temp probes as a proxy for fluid flow, two of our three flux integrator runs looked great, with clear differences in temp we can use to extrapolate flow. The third one shows oscillations that make me think we can entrain cold seawater around the skirt if we are not careful.

- [Cherisse] We completed mosaic and Temp/EhPh/ISMS surveys of TM chimneys (TM1C and TM2C) and completed a near bottom multibeam survey
- Monika: R1926-4: meiofauna collection for Sabine, R1926-10 various fauna from rock
- [Roxanne] conducted a second HPRS experiment comparing Alviniconcha with high and low-density spike hairs, which may correspond to different Alviniconcha species, when exposed to hydrogen sulphide.
- [Arunima] Sub-sampled from Roxanne's samples, eight *Ifremeria nautilei* for *in situ* tissue samples, and five individuals of *Alviniconcha* spp., one as a control and four for treatments for ship-based experiments.
- [Vicki] Acquired a few more lines of MB data to extend coverage (~2 hrs at end of dive + opportunistic data during near bottom transits)

April 16
2035 Recover ROPOS from Tu'I Malila (27 hr dive)

April 17
Time lost due to weather
Transit to islands to multibeam
April 18 Ship-based multibeam of new Tongan Islands (Hunga Tonga Hunga Ha'apai)

April 19
0800 Arrived port in Nuku 'alofa Tonga
New science crew arrives after shoreside outreach: Emily Estes, Sam Vohsen, Chuck Fisher
Pete Girguis, Vicki Ferrini, and Monica Bright depart.
April 20: In port

Leg 2

1700 Depart Nuku'alofa
April 21: Change clocks to Fiji Time at 0200

0814 Launch ROPOS on **Tui Malila for Dive 1927**
Ground fault in lights can, dive aborted at about 230m depth

1430 Launch ROPOS on **Tui Malila for Dive 1928**
Each study site was visited to obtain more T measurements for calibration curve
Started at the mushroom flange and took 4 additional T measurements without FI
Collected a mussel with Barnacles on the shell and slurped shrimp for Jessie.
Moved to Chimney site and took additional T measurements without FI
Tried to take IGT (gastight) samples at a chimney, but the devices were unresponsive.
Obtained additional chemistry measurements in TM1 and both TM peripheral sites
Mostly using the FI.
At some point the FI stopped detecting sulfide and it appears the inlet was clogged()
Collected assorted fauna into bioboxes (both snails and mussels) and also slurped Shrimp
Decided to recover, fix the IGTs and work on ISMS plumbing.
April 22:
1200 Recover ROPOS from Dive 1928 (21.5 hr dive)

1830 launch ROPOS on **Mariner for Dive 1929**
We found and re-mosaicked one chimney (not Pisa) Several ISMS measurements were taken on the chimney and there was plenty of sulfide in even the diffuse flow (6°). Mussels have also started to move into Mariner. We saw numerous single and small groups of mussels as well as a few patches of 30 or so animals. A pair of gas tight water samples were taken, assorted small animals slurped up for isotope measurements, and the entire site multibeam surveyed. We did not find the reported aggregation of tubeworms.
April 23:
0900 Recover ROPOS dive 1929 from Mariner (14.5 hr dive)

1350 Launch ROPOS on **Tui'malila for dive 1930**
The primary purposes of this dive was to get additional animals for experiments, Hi-T water samples and additional Flux Integrator samples. We started with the southern chimney complex and a ridge and collected to IGT samples. Water temps were a bit over 300°C and the collections went smoothly. However we spent over an hour trying to stow the samplers after collection. We then moved to the area adjacent to TM1 diffuse flow study site and made two Flux integrator quantitative collections with before and after collection Chemistry measurements. One collections was dominated by Alviniconcha and although the other appeared to be dominated by Ifremeria, there were Alviniconcha under those as well. We finished th dive by returning to peripheral site TMP1 and made a final ISMS measurement there in an orifice with slightly shimmering water coming from it. The T was about 20° sulfide and like our previous samples at this site there was NO sulfide present in the vent water. So, although there is abundant shimmering water sources at this site, the absence of sulfide explains the absence of typical symbiotic vent fauna at this habitat. Finished all work at Tu'I Malila so headed to the surface. We collected 4 Niskin samples on the way to the surface for Tongan collaborators.
2400 Recover from Tu'I Malila (10 hr dive)

2400 Begin transit up to ABE
April 24:
0200 Slowed down in transit to allow ROPOS group to work on an open electronic can.
0900 On station and considering launch
1000 WOW

1220 Launch ROPOS on **ABE for dive 1931**
We mosaicked, T probed and Chem surveyed 2 chimneys (potatoe is gone) in the N and Hogworts in the S and deployed new markers at each. We revisited the two diffuse flow, sites and the two peripheral site, deployed new markers and did additional Chem measurements at each, using the FI for the very low T measurements. ABE2 was very different, it seems to have collapsed and had multiple chimneys fall on it and was not recognizable. These activities took about 18 hrs. After this we searched for good sites for the flux integrator collections. We made two of these, one among a mix of Ifremeria and mussels and one excellent one of a small Alviniconcha patch. Shrimp were slurped from this second connection. This took about 8 hours and we decided to end the dive with a collection of fresh Alviniconcha and shrimp for shipboard work.
April 25:
1830 recover ROPOS from ABE (30 hr dive)

April 26:
0000 Launch ROPOS on **Tahi Moana for dive 1932**
0200 Landed on N area and found an active smoker near the marker. Moved to diffuse flow 3, where there was very little activity and one small clump of Ifremeria that could be suitable for flux integrator. Moved to Diffuse flow 4. Again, very little activity, but one nice small Alviniconcha site where we made a flux integrator collection and measurements. There is one other small clump of Alviniconcha here that would likely be suitable for a flux integrator collection. We then transited S toward the other active area. Passed lots of corals and glass sponges along the way. In the S the marker location is among many chimneys with only moderate activity, but flanges and very photogenic. We went towards the diffuse flow areas to the W and saw lots of ifremeria, no alviniconcha, but good areas for a diffuse flow study site, perhaps one linked to a peripheral study site
0830 Decide to end dive and move to Tow Cam because of excellent weather (and perhaps the only opportunity to dive on this deeper site).
1030 Recover ROPOS from Tahi Moana (10.5 hr dive)

loose fitting on Beast Cam delayed launch by about 2 hrs. Keith noticed and saved the day.

1520 Launch ROPOS on **Tow Cam for dive 1933**
Load on the A-frame was touch and go for most of the dive. We mosaicked both TC diffuse flow sites but the ROPOS dopler velocity nav was screwy. We redid many lines and set up spacing manually. Seems OK, but will involve manual work to put together high quality mosaicks. We also mosaicked the French chimney using the ROPOS DSC and took one chem measurement there. We moved to the tubeworm site, we found it quickly, but no sign of baby tubeworms there at all. Made a collection of Alviniconcha just in case we can find some on the shells and for Roxie. Made another chem measurement there. Moved back to TC2 to start the chem and T measurements. Spent most of the night making Chem and T measurements in the diffuse flow study sites. About 5 am switched to multibeam and covered most of the original multibeam by late morning before returning to the TC1 site to add another adjacent mosaic of the periphery (TC1P). After finishing the periphery mosaic we collected barnacles, zoanthids, anemones and slurped shrimp for particle tolerance experiments. Then back to TC1 and TC1P for temperature measurements within the mosaic site. At about 1630 we made our final collections of Alviniconcha and shrimp before leaving the bottom at 1700.
April 27:
1900 recover ROPOS from Tow Cam (25.5 hr dive)

2252 launch ROPOS **Tahi Moana for dive 1934**
April 28:
During this dive we concentrated our efforts on the Southern area. We explored all of the way-points from the 2009 visit and found a fair amount of diffuse flow from basalt, but there were no Alviniconcha at all in the basaltic diffuse flow. There are some of the most spectacular chimneys we have seen at any site on this cruise, both live and dead chimneys. We set up 2 diffuse flow study sites and 2 peripheral study sites (one P site was immediately adjacent to one of the diffuse flow sites). At both sites we collected the imagery for the mosaics, collected multibeam, and left markers. We then made two flux integrator collections of Ifremeria in this

region. We moved to one of the chimneys for a small collection of Alviniconcha before setting up to multibeam. The multibeam was very problematic: although it seemed to be working, it was often not capturing (saving) the data and leaving large holes in the data set. We gave up on the multibeam at 1730 and moved to do some chem and T at the Marker F14 diffuse flow site. At 1915 we began the one hour transit N to the potential Alviniconcha FI site. Shortly after arrival we began trying to set up for a FI and it was not going well and the flow was weak. Weather deteriorated. We collected one scoop and noticed that some of the Alviniconcha were dead. So we moved to a new location and collected two scoops from vigorous flow into a different chamber of the box and left the bottom. We need to return to this location and collect chemistry data on another dive.
2300 Recover from Tahi Moana (23.5 hr dive)

Beastcam had a cracked port upon recovery so the entire stereo camera rig and strobes was taken off and we will use the ROPOS DSC to mosaic chimneys at Tahi.

April 29:
0800 WOW
1800 ran to Hunga Tonga Hunga Ha'apai to continue multibeam survey.
April 30:

0715 dive on **Tahi Moana for dive 1935**
Went to Chimney TH1C and took IGT pair. 274° and 280°. Moved to long term study sites (TH1, TH2, TH1P, TH2P) and collected T and chem at all 4 sites. Make a Flux Integrator mussel collection near F19 with additional chem for this site. Moved to F14 and collected samples the colonial soft octocoral for ID. Moved to "go here" and scooped additional Ifremeria for Arunima.
2000 proceeded to chimneys for chimney mosaic work and mosaicked 2 chimneys and then were warned of impending weather. multibeamed our way to the Southern end of the site and made an Alviniconcha flux integrator collection. At this point weather had deteriorated so we made three scoops of Alviniconcha for Jessie's experiments, made achem measurement here (the same place that we collected for Roxie on the last dive), and headed to the surface.
May 1:
0214 recover ROPOS from Tahi Moana
0800 WOW heading to Hunga Tonga Hunga Ha'apai to continue multibeam survey
1100 stop ship to evaluate weather
May 2:
0600 Weather is bad and building. Pulled into lee of the island to attempt to remove the docking head from the crane. No luck. Craned gas cylinders and some science gear between decks.
1000 Start transit back to Suva with following 4 m seas.
May 3: Transit
May 4: Arrive Suva at 0800, one day early to pack heavy equipment
May 5:

Dive plans (both legs) and watch summaries (Leg 2)

Leg 1

Dive Plan

Dive #: 1922
Date: 10/4/2016
Est. launch time: 1500
Estimated dive length: 18-24 hours

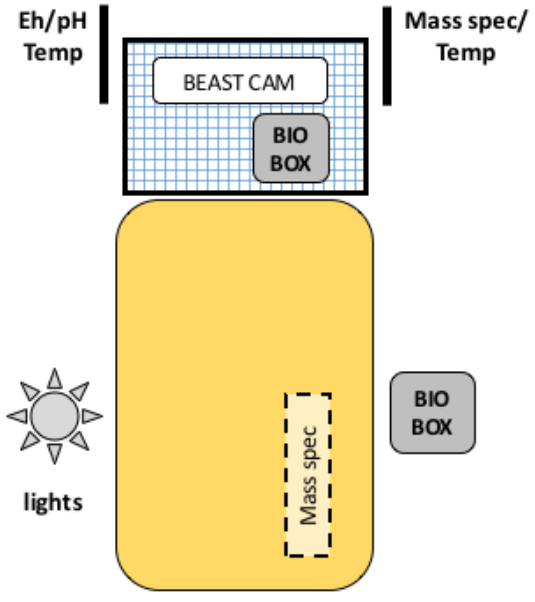
Launch LAT/LONG: 20.76639 , 176.1926

Recovery LAT/LONG: wherever

Approx. depth at bottom: 2131 meters

Name of site: ABE

Vehicle configuration



TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	**YES**
Flux integrator	
Mini-flux integrator	
Markers	
IGT (gastight)	
Protist traps	**YES**
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	**YES**
Beast Cam, forward-looking	
Multibeam	**YES**
Mass spec	**YES**

Dive activities

(1) On the way to bottom, turn on power to mass spec and start the roughing pump.
(2) At bottom, fly around the sites to identify the long-term study sites (diffuse flow and peripheral) and take some pics and drop waypoints on ROV nav.
(3) Then, we will head to the **ABE2-P** long-term study sites–a peripheral site- to work at for the next few hours.
(4) Once there, set up to run one or two multibeam sonar lines at 20 meters to assess if we can get the resolution we want from that altitude. This will take ~30 minutes.
(5) At that point, find Vicki and get her the sonar data to play with and calibrate etc. This should be completed within an hour.
(6) Then re-position the vehicle to do photomosaicing at 2 m altitude of the **ABE 2P** site. Run the multibeam concurrently.
(7) Once photo mosaic is complete, use Eh/temp probe to collect fine-scale data within and among the animals. Cherisse and Arunima leads this effort.
(8) Transit to the ABE-1 study site.
(9) Then re-position the vehicle to do photomosaicing at 2 m altitude of the **ABE 1** diffuse flow site. Run the multibeam concurrently.
(10) Once photo mosaic is complete, use Eh/temp probe to collect fine-scale data within and among the animals. Cherisse and Arunima leads this effort.
(11) Then find good "vigorous" diffuse flows in the **ABE-1** study site. Set up to take ISMS readings of these locale.
(12) We will then repeat this photomosaic and sonar survey for the **ABE-1** peripheral study site, following the routine presented above. Definitely use Eh and temp at these sites; not likely to use mass spec.
(13) OPTIONAL: Assess the time. If we can spare 15-20 minutes, collect Beth Orcutt's FLOCS experiments from 20° 45.7917S and 176° 11.4818W, in 2148 m water depth, near some markers on the other side of a snail bed. it is essentially a set of 4" white PVC rings strapped together with a rocks.
(14) Head up to the NORTH towards the chimney complex and the **ABE-2 D** study site. Collect multibeam along the way.
(15) Drop off protist traps for Roxie at the chimney complex.
(16) Collect medium to high temp sulfides of any kind. We need a decent size sample if possible.
(17) If there is time, set up to photomosaic **ABE-2 DIFFUSE** as outlined above (mulitbeam, photomosaic, Eh, and ISMS)
(18) Collect *Alviniconcha*. Take good digital stills of these *in situ* first, then find Roxie who will direct collections.

Opportunistic sampling

Look for an anemone, barnacle, crab, shrimp to collect with the suction sampler

Dive Plan

Dive #: R1923

Date: TBD pending weather
Est. launch time: TBD pending weather
Estimated dive length: TBD pending weather

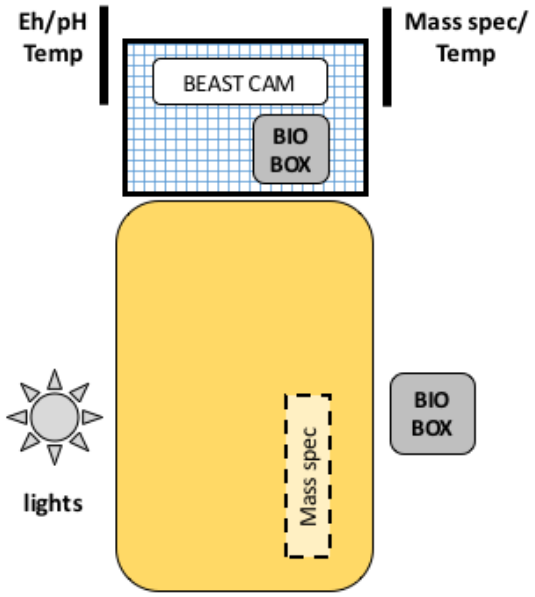
Launch LAT/LONG: -176° 34.025 , -21° 59.325

Recovery LAT/LONG: TBD

Approx. depth at bottom: 1890 meters

Name of site: Tui Malila

Vehicle configuration



TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	
Flux integrator	
Mini-flux integrator	
Markers	
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	**YES**
Beast Cam, forward-looking	
Multibeam	**YES**
Mass spec	**YES**
Niskins	
Suction sampler	
MARKERS	**YES**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Add._ mrkr	H	Lat.	Long	Depth
TM1	Lava	43	42, 44	132	-21.98911	-176.56823	1888
TM2	Flange (lava)	35		68	-21.98973	-176.56848	1879
TM1P	Periph. lava	45	38, 39, 41	257	-21.98917	-176.56838	1883
TM2P	Periph. lava	61	59, 60	144	-21.98936	-176.56818	1879
TM1C (back)	Chimn.	62		339	-21.98803	-176.56777	1894
TM2C (front)	Chimn.	62		78	-21.98799	-176.56783	1894

Bio Sampling Site Names/Positions

Site	Site type	Lat.	Long	Depth
TM-1	Chimney wall	-21.989333	-176.568333	
TM-2	Diffuse flow	-21.989500	-176.568500	
TM-3	Diffuse flow	-21.989167	-176.568167	

Dive activities

(1) STOP AT 200 meters water depth

a. Turn on power to mass spec and start the roughing pump. Make sure we have comms. and power etc.

b. Then, turn on Eh/pH and confirm data acquisition. MAKE SURE CAPS ARE OFF!

c. If all looks well, proceed.

(2) PHOTOMOSAICING and multibeam

a. Get to bottom. We are going to start photo-mosaicing/multibeam at TM1 (see tble above for positions). This is photomosaicing and multibeam only, no temp yet.
b. Find Cherisse and get her to start stiching together the pics.

(3) Multibeam Lines moving south from TM1

(4) Transit back to mosaic site TM1P

a. Photomosaic and multibeam TM1P.
b. Next proceed to photomosaic and multibeam TM2P.
c. Finally, photomosaic and multibeam TM2.

(5) Multibeam remaining lines to the North

a. When finished transit back to TM1 for temp, Eh, ISMS

(6) Temperature survey, Eh and ISMS

a. Take the ROV and start the temperature survey using the Eh/pH probe
b. Start at site TM2, and use the probe GENTLY to survey. Then, find site to do ISMS. Get Pete or Sean!
c. Proceed to site TM2P. Temp survey / Eh only.
d. Proceed to site TM1P. Temp survey / Eh only.
e. Finally, proceed to site TM1. Temp survey and ISMS.

(7) Animal collection

a. These collections need to be done with precision. We will be collecting *Alviniconcha* primarily. Roxie would like to collect these as VERY small collections per her instructions. Each collection should be kept SEPARATE from one another. (find Roxie for sample collection)
b. Time permitting, we will collect other peripheral species as well (find Jessie)
c. Please try to leave ONE divider box open for sulfides

(8) Sulfide collections

a. Time permitting, we will collect high temp sulfides and place in the bio box.

Opportunistic sampling

Look for an anemone, barnacle, crab, shrimp to collect with the suction sampler

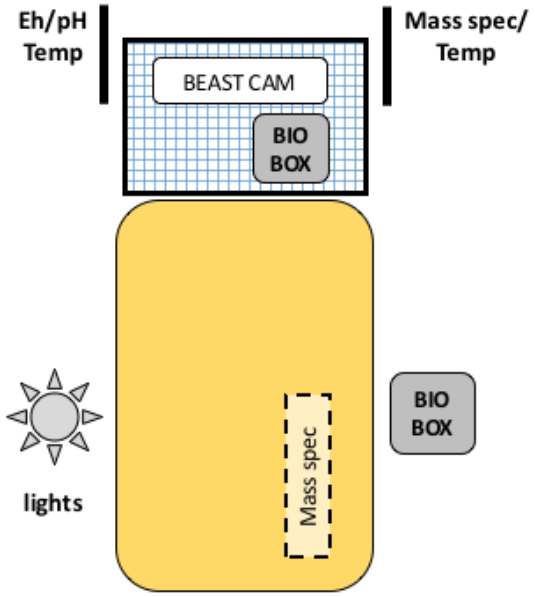
Dive Plan

Dive #: 1925

Date: Friday April 15th (local time/date)
Est. launch time: 1300
Estimated dive length:

Launch LAT/LONG: -176° 34.025 , -21° 59.325
Recovery LAT/LONG: TBD
Approx. depth at bottom: 1890 meters
Name of site: Tui Malila

Vehicle configuration



TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	**YES**
Flux integrator	**YES**
Mini-flux integrator	
Markers	**YES**
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	**YES**
Multibeam	**YES**
Mass spec	**YES**
Niskins	**YES**
Suction sampler	**YES**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Add._ mrkr	H°	Lat.	Long	Depth
TM1	Lava	43	42, 44	132	-21.98911	-176.56823	1888
TM2	Flange (lava)	35		68	-21.98973	-176.56848	1879
TM1P	Periph. lava	45	38, 39, 41	257	-21.98917	-176.56838	1883
TM2P	Periph. lava	61	59, 60	144	-21.98936	-176.56818	1879
TM1C (back)	Chimn.	62		339	-21.98803	-176.56777	1894
TM2C (front)	Chimn.	62		78	-21.98799	-176.56783	1894

Bio Sampling Site Names/Positions

Site	Site type	Lat.	Long	Depth
TM-1	Chimney wall	-21.989333	-176.568333	
TM-2	Diffuse flow	-21.989500	-176.568500	
TM-3	Diffuse flow	-21.989167	-176.568167	

Dive activities

(19) During descent

On the way to bottom, turn on power to Eh/pH and mass spec and start the roughing pump.

(20) **Flux integrator testing and animal collections**

- **a.** Start at TMI Lava (the long-term study site).
- **b.** Look for *Alviniconcha*, *Ifremeria*, and *Bathymodiolus* clump that's fairly removed from other animals (few mussels) and FLAT.
- **c.** Start by photomosaicing using the downward-looking ZeusCam from the ROV. Can we record this video?
- **d.** Place flux integrator OVER animal patch. Make sure that the "skirt" has a soft seal. Look for signs of fluids flow out top.

e. Then, if flow is evident, take ISMS reading by inserting ISMS probe about 1" into the stovepipe.

f. Then, do Eh/pH by inserting 1" into the stovepipe.

g. Then…IF POSSIBLE…insert the Eh/pH OR the ISMS probe (whichever is easier) into the stove pipe and get temp about 4" into the stovepipe.

h. Then…clear ANY animals that are around the OUTSIDE of the flux integrator.

i. Lift up flux integrator and CAREFULLY COLLECT all the animals that were under the integrator. Each of these collections should be kept SEPARATE from one another. (find Roxie for sample collection)

j. Then, place flux integrator back onto the same spot, but this time with no animals. Repeat ISMS and Eh/pH measurements.

(21) Collect rocks from UNDER the cleared animal patch

a. Try and collect animals from under the cleared patch

(22) Go to peripheral site and collect non-symbiotic snails

a. Try and collect animals from near the peripheral sites

(23) Multibeam to North above middle platform of fault scarp – go to top-most MB survey line

a. Re-run line from W to E @ 20m altitude
b. Drop to 15m altitude
c. Turn and head to TM1C (MB along the way)

(24) PHOTOMOSAIC and multibeam the one chimney

a. Vertical photo-mosaic at TM1C and TM2C CHIMNEY (see table above for positions).
b. Fly slow multibeam lines over top of TM1C and TM2C CHIMNEYS and then run MB lines AROUND chimneys (same altitude as previous Chimney runs).
c. Eh/pH and mass spec.
d. One more pass of Multibeam complex from above

(25) **Multibeam to South**

a. Transit along eastern extent of MB coverage (to extend coverage)
b. One more line along the southern extent of coverage if possible.
c. Fly over chimneys in SW corner to get more coverage of chimneys

(26) Sulfide collections

a. Time permitting, we will collect high temp sulfides and place in the bio box.

(27) EELPOUT and BARNACLE collections

b. Time permitting, we will collect eelpouts and barnacles with the suction sampler

(28) **STANDY**

a. …for more instructions as we stop and assess our progress and come up with a plan for the remainder of the dive.

Opportunistic sampling

Collect barnacles, crab, shrimp to collect with the suction sampler

Leg 2

Dive Plan
Dive #: 1928

Date: Thursday April 21th (local time/date)
Est. launch time: 0800
Estimated dive length: 24 hr

Launch LAT/LONG: -21.98973, -176.56848

Recovery LAT/LONG: TBD

Approx. depth at bottom: 1890 meters

Name of site: Tui Malila

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

IGT on Swing Arm
Flux integrator
One Temp wand plumbed for eh/pH and ISMS

No multibeam this dive
No mosaicking this dive
Collection scoop(s)
Slurp sampler

Mosaic Site Names/Positions

TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	
Flux integrator	**YES**
Mini-flux integrator	
Markers	
IGT (gastight)	**2**
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	**YES**
Multibeam	
Mass spec	**YES**
Niskins	**2**
Suction sampler	**YES**

Site	Site type	Mrkr	Add._ mrkr	H°	Lat.	Long	Depth
TM1	Lava	43	42, 44	132	-21.98911	-176.56823	1888
TM2	Flange (lava)	35		68	-21.98973	-176.56848	1879
TM1P	Periph. lava	45	38, 39, 41	257	-21.98917	-176.56838	1883
TM2P	Periph. lava	61	59, 60	144	-21.98936	-176.56818	1879
TM1C (back)	Chimn.	62		339	-21.98803	-176.56777	1894
TM2C (front)	Chimn.	62		78	same	same	1894

Dive activities

1) Dive on TM2 (the flange site) Collect 4 additional Chem measurements using the ISMS. With and/or without flux integrator. (Chuck Lead)
2) Move to TM1C (chimney site). Collect additional 4 additional chemistry T pairs with ISMS. On this chimney is best, but can be adjacent chimney if necessary (Chuck/Cherisse)
    a. Collect a pair of IGT Gas Tight samples from focused flow. At experimental chimney if possible. Also collect an ISMS sample from this location (Sean lead)
3) Move to TM1 area (note can mix up order of below activities b, c, d. based on personnel availability and opportunity) (Cherisse/Chuck)
    a. Collect a piece of rock with barnacles.
    b. Make 3 quantitative flux integrator collections (two Alvinoconcha and one Ifremeria) (Roxanne)
        i. Image collection location with down-looking Zeus cam
        ii. Place FI and make chem measurement.
        iii. Remove animals from around FI
        iv. Remove FI and collect all animals into bio box
        v. Image collection site
        vi. Make new FI measurement
    c. Make at least 3 additional diffuse flow chem measurements
        i. Try some with flux integrator on low T flow
    d. Slurp some shrimp

Watch Standers Report R1928: Tu'i Malila
Launch: April 21, 2016, 1430
Recovery: April 22, 2016, 1200

1200 – 1600 Fanny Girard
Started the dive at 14:43.
My shift ended before we reached the bottom. We had to synchronize the two imaging computers, as they were unplugged at the end of leg 1. Other than that nothing happened during the descent.
1600 – 2000 Jenny/Jessie
This watch started out with determining the residence time through the ISMS tubing by filling with ambient water, moving to vent water, and timing the introduction of a hydrothermal signal. We used hydrogen sulfide as an indicator of hydrothermal fluid and determined the flush time to be about 8 minutes (** note we later determined that flow was slow on this measurement, all others indicate 2.5 to 3.5 minutes**). We ended up taking a total of three ISMS samples. Next, we collected a piece of chimney with lollipop worms and barnacles for Jessie to examine for their potential use in future particulate experiments. Two additional ISMS samples were taken, which took a long time due to difficulty in finding a location that had steady temperature readings.
2000-0000 Sam Vohsen
We set up between TM1C and TM2C at marker F3 and got a CHEM measurement and two dead volume tests. Sean then took over but he couldn't communicate with his IGTs so we moved on after about 30min. Cherisse came back and we took several more CHEM measurements at adjacent locations at varying temperatures.
00:00—04:00 Emily Estes
We conducted extensive ISMS and temperature measurements at Tui Malila sites TM1, TM2, TM1C, TM2C, TM1P, and TM2P. At all sites, we attempted to locate and conduct ISMS analyses along a temperature gradient in order to construct a temperature vs. chemistry curve indicating how much seawater is entrained into diffuse flow. At sites TM1 and TM1P/TM2P most analyses were regions of lower-temperature diffuse flow that were sampled using the flux integrator. We calculated the dead volume of the tubing and the flow rate through the tubing to the mass spec several times by flushing with ambient sea water and then sticking the probe into vent fluid, coming up with approximately 2 mins 40 seconds dead time. Low temperature vent fluids had extremely low H2S, comparable to that measured in background seawater. We are uncertain whether this is real, a limit-of-detection issue, or another issue with the mass spec/particles clogging the tubing. Additional sampling tests on the next dive will hopefully resolve this question.
0400-0800 Fanny Girard (Sean's watch)
I started this watch at TM1P. We took 3 ISMS measurements using the flux integrator at three different spots. We then moved to TM2P, and took 2 ISMS measurements using the flux integrator. We found some high temperature spots but did not detect any sulfides with the mass spectrometer. Once done with these measurements Roxie took over and we decided to go to TM1 to do flux integrator collections. As we suspected that the mass spectrometer could be clogged, we stopped at the waypoint called "Milkyway" to test it. We did not use the flux integrator and stuck the probe directly into the smoking hole. It did not seem to detect sulfides either.
0800-1200 Arunima Sen

We were not sure if the ISMS was working so we tested it in `Dara`s Smoky Hole`and also at ambient conditions to see if it was detecting sulfide. It did not seem like it was detecting sulfide (Scan time was from 19:46:32 to 20:06:19).
Then we looked around for flux sites. Since we didnt see any quickly, we returned to the TM1 adjacent site to collect Alviniconcha for experiments (20:25:06; Sample Number R1928-4, put in box PF2). Then we moved to the TM2P site and took a few temperature measurements since higher than ambient tempertures had been recorded there (20:55:22 to 21:10:49). We returned to the TM1 adjacent site and scooped mussels for Verena and other animals for practising for experiments (at 21:23:56, 3 scoops, Sample Number R1928-5, put into PF1 box). We also took two scoops of apparently small sized Ifremeria for me at the same site (at 21:30:34, Sample Number R-1928-6, put into PF3 box). Then we suctioned shrimp, both for Verena and for Jessie to practice with, also at the same site (at 21:48:09, Sample Number R1928-7, went into Jar 2). At this point we were done with the dive and started surfacing at 22:08:40. On the way up, we took four Niskin samples for Tonga: at 1396 m (port forward, Sample Number R1928-8, at 22:36:13), at 1000m (port aft, Sample Number R1928-9, at 22:36:13), at 500 m (starboard forward, Sample Number R-1928-10, at 23:26:41) and at 250 m (starboard aft, Sample Number R1928-11, at 23:39:54).

Dive Plan

Dive #: 1929

Date: Friday April 22th (local time/date)
Est. launch time: 1500
Estimated dive length: 20 hr

Launch LAT/LONG: - 22.1804245, - 176.60148

Recovery LAT/LONG: TBD

Approx. depth at bottom: 1890 meters

Name of site: Mariner

Vehicle configuration

One biobox, Forward platform
IGTs on Swing Arm
Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Multibeam this dive
Forward mosaicking this dive

Standard equip.
Collection scoop(s)
Slurp sampler

TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	
Flux integrator	**YES**
Mini-flux integrator	
Markers	**3**
IGT (gastight)	**2**
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	**YES**
Multibeam	**YES**
Mass spec	**YES**
Niskins	**4**
Suction sampler	**YES**

Mosaic Site Names/Positions

Site type	Mrk	Head	Lat.	Long	Depth
Chimney		**324**	**-22 10.818**	**-176 36.063**	**1904**
Chimney Pisa	**7m to 94**	**64**	**-22 10.8252**	**-176 36.1002**	**1912**
Pisa (from ALR)			-22 10.82217	-176 36.11561	
Tubeworm			**22.10.820308**	**176.36.10396**	
ALR	94		-22 10.81747	-176 36.09602	
ALR	X15		-22 10.80874	-176 36.09258	
ALR	ALR2		-22 10.80717	-176 36.07219	
ALR	S		-22 10.79301	-176 36.12305	

Dive activities

1) Dive on middle of site and collect multibeam from 20 m altitude (Sam/ROPOS team, about 7 hrs)

2) Take a look around, go to Tubeworm site, Slurp a variety of mobile fauna (shrimp, little crabs, little snails, worms, etc.) Collect a few small tubworms if possible (Chuck)

3) Move to XXX (chimney site). Mosaic (Cherisse)

- **a.** Collect 3-4 ISMS measurements

4) Move to YYY (chimney site) Mosaic. (Cherisse)

- **a.** Collect 3-4 ISMS measurements

5) Collect IGT and take an ISMS measurement (Sean)

6) IF find snails or mussels, consider FI measurements and collections. FI measurements at the least

7) Leave the bottom. Collect 4 niskins on the way up (near bottom, 1,000 m, 500 m, 50 m depths

Watch Standers Report R1929: Mariner

Launch: April 22, 2016, 1830
Recovery: April 23, 2016, 0900

1830 – 2000 Jessie/Jenny
This watch started out with ROPOS getting into the water at 16:49, and it ended before the vehicle reached the bottom.
2000 – 0000 Sam Vohsen
Hit bottom at 8:30pm and started to look for MAR2 = Pisa. Found other researchers' markers and found a large chimney many meters tall near one of our old markers. We determined that it was MAR1 = Chimney Top. We did a vertical mosaic using forward-facing beastcam and took some chem measurements. We tried to find the chimney with tubeworms for a while, couldn't, then gave up. Took a slurp sample of shrimp and a crab for stable isotopes. At about 11:30pm, started multibeam.
0000 – 0400 Emily Estes
We conducted 7 multibeam lines running N/S over 250m at 20m altitude and max speed of 0.3 to 0.4 knots. Two additional crosslines were added going over a particularly tall chimney feature observed and over chimney F5, where the mosaicking occurred and where Sean will collect high-temperature samples. In the final hour of watch, we slurped additional shrimp and crabs from a chimney feature and positioned for Sean's gas-tight samples.
04000 – 0800 Sean Sylva
We sampled crabs at chimney F5. We probed for high T vents with good orifices for Gas Tight sampling (IGTs) which included some alternate chimney investigations. Finding no better candidates we sampled two IGT's (IGT4 and IGT6) at Chimney F5 with 340^{o}C constant Temperatures. Handling of the IGT's was a challenge and it took significant time to handle them safely back into the milk crate. Discussion regarding alternate basket configurations. Two sulfide samples were collected and placed in the biobox. We then performed a chemistry measurement with the ISMS at the same orifice as the IGT sampling.
0800 – 0900 Arunima Sen
Niskin sample was taken at about 750 m depth (starboard aft, at 20:17:39) and at 50 m (starboard forward at 20:54:35). At 21:09:20, ROPOS was ou of the water and at 21:10:53, it was back on deck.

Dive Plan

Dive #: 1930

Date: Friday April 23th (local time/date)
Est. launch time: 1300
Estimated dive length: 12 hr

Launch LAT/LONG: -21.99050, -176.56917

Recovery LAT/LONG: TBD

Approx. depth at bottom: 1890 meters

Name of site: Tui Malila

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

IGT on Swing Arm
Flux integrator
One Temp wand plumbed for eh/pH and ISMS

No multibeam this dive
No mosaicking this dive

Standard equip.
Collection scoop(s)
Slurp sampler

TOOL	TAKE ON DIVE?
Snail scoops	**YES**
Nets	
Flux integrator	**YES**
Mini-flux integrator	
Markers	
IGT (gastight)	**2**
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	**YES**
Multibeam	
Mass spec	**YES**
Niskins	**2**
Suction sampler	**YES**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Add._ mrkr	Head	Lat.	Long	Depth
TM1	Lava	43	42, 44	132	-21.98911	-176.56823	1888
TM2	Flange (lava)	35		68	-21.98973	-176.56848	1879
TM1P	Periph. lava	45	38, 39, 41	257	-21.98917	-176.56838	1883
TM2P	Periph. lava	61	59, 60	144	-21.98936	-176.56818	1879
TM1C (back)	Chimn.	62		339	-21.98803	-176.56777	1894
TM2C (front)	Chimn.	62		78	same	-same	1894
WP1	Chim	none		325	-21.99050	-176.56917	1846

Dive activities

1) Dive on Chimney area, WP 1.
    a. Take a pair of IGT samples (Sean)
    b. Look around for Flux Integrator site for Roxie
2) Move to TM1 area
    a. Make quantitative flux integrator collections (Roxie)
        i. Image collection location with down-looking Zeus cam
        ii. Place FI and make chem measurement.
        iii. Remove animals from around FI
        iv. Remove FI and collect all animals into bio box
        v. Image collection site
        vi. Make new FI measurement
    b. Collect additional Alviniconcha and/or Ifremeria collections as needed
    c. Make additional FI chem measurement
3) Leave bottom by 10 pm.

Watch Standers Report R1930

April 23, 2016
Tuì Malila
Launch: 13:47
Recovery: 0011 (April 24, 2016)

13:47 - 1600 Fanny Girard
We started the dive at 13:47 and reached the bottom without any issues at 15:30. We went to the first waypoint but did not find the chimney. We looked around and found a black smoker for IGT. The temperature of the flux was above 300°C. We were getting ready for IGT sampling when my watch ended.
1600 - 2000 Jessie/Jenny
Tried to get IGT samples, but they did not work. Transited to the TM1 site and adjacent to the mosaic area, we found an Alviniconcha patch to flux. Conducted first flux of the cruise (F1). Animals collected were Alviniconcha and Ifremeria and they were put in the PF2 biobox. Started a second flux.
2000 - 0000 Sam Vohsen
Completed a flux integrator series. Too many animals so we didnt remove them all. Lost power to something that made us jump for its final mass spec measurement so we sat done and redid it. Went back to TM2P and stuck the wand in a whole and measured 0 sulfide. Ascended and fired niskins at bottom, 1000m, 500m, 50m.

Dive Plan

Dive #: 1931

Date: Sat April 24th (local time/date)
Est. launch time: 1100
Estimated dive length: 24 hr

Launch LAT/LONG: -20 45.6744, -176 11.436

Approx. depth at bottom: 2140 meters

Name of site: ABE

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Forward looking Beast Cam
Strobe on swing arm

No multibeam this dive
No IGTs this dive

Collection scoop
Slurp sampler
Niskins

TOOL	TAKE ON DIVE?
Snail scoops	**yes**
Nets	
Flux integrator	**yes**
Mini-flux integrator	
Markers	**Yes, 6**
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	**Yes**
Multibeam	
Mass spec	**Yes**
Niskins	**4**
Suction sampler	**Yes**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Add. mrkr	Head	Lat.	Long	Depth
ABE1	Lava	52	50,51	270	-20 45.7908	-176 11.4816	2147
ABE2	Lava	32	46	342	-20 45.6786	-176 11.4246	2142
ABE1P	Periph.	53	46,48	314	-20 45.7728	-176 11.4954	2133
ABE2P	Periph.	63	65	52	-20 45.9834	-176 11.556	2131
ABE1C (Bugs Bunny)	Chimney	G		-331	-20 45.6744	-176 11.436	2141
ABE2C (Hogwarts)	Chimney	AA		-97	-20 45.9468	-176 11.5884	2131
ABE3C (Spire)	Chimney			-76	-20 45.672	-176 11.4366	2141

Dive activities

1) Dive on Chimney sites and do photomosaics with T on each
    a. Include 4-6 ISMS measurements per "set of" chimneys (1 set at hogwarts and another for the others) Leave additional marker if needed (Cherisse)
2) Move to lava and peripheral sites and collect additional ISMS measurements to a total of 6 per site (use FI as needed) Leave additional markers if needed (Cherisse)
3) Make 3 quantitative flux integrator collections (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement
4) Collect additional Alviniconcha and Ifremeria as needed

Watch Standers Report R1931

ABE
April 24, 2016
Launch: 0022
Recovery: 0637 (April 25, 2016)

1200 - 1600 Fanny Girard
We started the dive at 12:22 and reached the bottom at 14:00. We found ABE1C easily and deployed a new marker, as the old one was not very visible anymore. The new marker is F6 (blue and yellow bands) and was deployed next to ABE1C. We then made a first attempt to mosaic ABE1C. As some of the photos taken previously with the stereo cameras were a little blurry, we decided to dim the ROV lights while imaging the chimney. We started to image it from a distance of 3m but some of the images were too bright so we decided to try again a little further away (4m). The second attempt was a success. Once the mosaicking done, we started taking temperature/chemistry measurements. We took 28 temperature and 2 mass spectrometry measurements. My watch ended while we were taking the last ISMS measurement.
1600 - 2000 Jessie/Jenny
Looked for spire. Checked out a flange then did a mosaic of spire. Started temperature series at spire. Jenny arrived at 5 pm.
Did temperature series of spire. Couldn't do profiling of very top because it was unstable. An adjacent chimney was knocked over, but the debris did not seem to have compromised the next site, a diffuse site at MKR 32. Started setting up first Mass spec and then Jessie arrived at 5:58. Chem survey being done at ABE2. Two successful ISMS scans taken (IS3 and IS4). On IS3 temperature mostly held steady on first one (dipping down to 15C from 20C at one point). Second IS4 temperature held steady. After reviewing photos and double-checking with the marker it was determined that this site has changed dramatically from 2009. We see less fauna, more rubble now. Looked for another high temperature flow for the ISMS. Cherisse took over logging at 7:28.
2000 - 0000 Sam Vohsen
We finished mass spec measurements at ABE2 adjacent. We fired a niskin sample on bottom. MOved to ABE1P and took some temperature measurements and 3 mass spec measurements. Found some unknown six-legged arthropod that we slurped. We then moved to ABE1, deployed a marker and did a third mass spec measurement for the location.
0000 - 04000 Emily Estes
With watch leader Cherrisse, we started at ABE 1 and conducted several temperature and ISMS measurements. At ABE2C, the study site was mosaicked, marker F9 added, and 37 temperature measurements made over bare rock, mussels, snails, and mats, and 5 ISMS measurements were taken along a temperature gradient diffusing from the study site. At 15:41 a fish was observed.
0400 - 0800 Sean Sylva
Continued temperature measurements and ISMS scans using the Flux Integrator at ABE2C. We then transited to ABE2P where we also performed temperature measurements and additional ISMS scan using the Flux integrator. ABE2P presented challenges due to lower flow rates so finding a suitable area took some time. Along the way from ABE2C to ABE2P we encounterd some glass sponges that were photographed as highlights.

0800 - 1200 Arunima Sen

Mass spec chemical measurement was ongoing at the start of the watch and was finished within a few minutes. Then we started moving to the ABE1 site to find spots for the flux integrator. Along the way, we got some nice views of a few different flange pools on a big chimney structure. Roxie came on as watch leader and we looked for the Roxie2 waypoint, but didn't find any good aggregations there. So we headed instead to the Roxie1 waypoint and along the way we saw some interesting animals, such as a big, brisingid seastar, a yellow crinoid, basket sponges, a pink/orange octocoral and a Dumbo octopus (which we took numerous pictures of). At Roxie1, we found a good patch of Ifremeria and mussels and we put the flux integrator down over it, took an ISMS measurement (scan from 22:07:09 to 22:17:41), cleared the animals and collected the animals into the starboard biobox (compartments SF2 and SF3). IRLS pictures were down for some of the flux work.

1200 - 1600 Fanny Girard

Roxie was re-deploying the flux integrator, after all the animals were cleared, when my watch started. We finished the first flux integrator collection (F7) and decided to go to ABE1 to look for an *Alviniconcha* patch for another collection. We looked around ABE1 for a while and found an isolated *Alviniconcha* (with a few *Ifremeria*) patch that was not part of the long-term study site. We did a second flux integrator collection (F8). We kept looking in the same area for another patch for the last collection but did not find any that were good enough. Therefore, we decided to go check the Hogwarts area. We found a *Alviniconcha*/*Ifremeria* patch on the way and dropped a waypoint ("POTENTIAL FLUX") so that we could come back in case we did not find anything near Hogwarts. As there were no animals that we could collect at Hogwarts we went back to the "POTENTIAL FLUX" waypoint. The patches there were not ideal for a flux integrator collection, so we decided to give up and collect some animals for high-pressure experiments instead.

1600 - 2000 Jessie/Jenny

Did ISMS measurement at a patch of Alviniconcha; then collected snails using suction sampler and scoop for Roxie and Arunima. Collected a few more shrimp for Jessie. Put Mayor McCheese away and then left bottom. Collected Niskins at 1,000 m, 500 m, and 50 m for Tonga.

Dive Plan

Dive #: 1932

Date: Sat April 24th (local time/date)
Est. launch time: 2400
Estimated dive length: 36 hr

Launch LAT/LONG: -20 40.4353, -176 10.80374
Approx. depth at bottom: 2260 meters
Name of site: Tahi Moana

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Down- looking Beast Cam
Strobe on swing arm
Multibeam this dive

No IGTs this dive

Standard equip.
Collection scoop
Slurp sampler
Niskins

TOOL	TAKE ON DIVE?
Snail scoops	**yes**
Nets	
Flux integrator	**yes**
Mini-flux integrator	
Markers	**Yes, 6**
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	**Yes**
Beast Cam, forward-looking	
Multibeam	**Yes**
Mass spec	**Yes**
Niskins	**4**
Suction sampler	**Yes**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Lat.	Long	Depth
N-Tani		X13	-20 40.4353	-176 10.80374	
N-Tani	Diffuse flow 3		-20 40.42314	-176 10.82322 -176 10.82322	
N-Tani	Diffuse flow 4		-20 40.4133	-176 10.85784 -176 10.85784	
S-Tani		X1	-20 40.90618	-176 10.96055	
S-Tani		X14	-20 40.93173	-176 10.99741	
S-Tani	Diffuse flow 1		-20 40.88712	-176 10.94496	
S-Tani	Diffuse flow 2		-20 40.902	-176 10.947	
S- Tani	Diffuse flow 5		-20 40.99848	-176 11.01468	
S- Tani	Diffuse flow 6		-20 40.98	-176 10.98384	
S- Tani	Diffuse flow 7		-20 40.93512	-176 11.01246	
S- Tani	Diffuse flow 8		-20 40.92756	-176 11.02248	
S- Tani	Diffuse flow 9		-20 40.89408	-176 10.93734	

Dive notes: This is a new site for us and decisions will need to be made "on the fly". Decision points include when to do the site multibeam lines and whether we should break up the multibeam surveys (N and S). We need some activity between collecting imagery for mosaic and doing the T/chem surveys of those sites (either FI collections or multibeam). We can break this up into two dives if needed. We will need at least one other dive for forward looking imaging and IGTs. The last thing done before ending the dive should be either a FI collection or a separate collection for shipboard experiments that includes Alviniconcha.

Dive activities

1) Dive on northern area , Marker X13
2) Turn on multibeam
3) Conduct recon and identify diffuse flow, chimney, and peripheral areas for further study and sampling with digital targets.
4) Transit to Southern area.

5) Conduct recon and identify diffuse flow, chimney, and peripheral areas for further study and sampling with digital targets.
6) Choose an area to establish long-term monitoring diffuse flow community "Tahi 1" (Cherisse)
    a. Deploy a marker.
    b. Conduct combined photomosaic and multibeam survey.
7) Choose an area to establish long-term monitoring peripheral community "Tahi 1P"
    a. Deploy a marker. (Cherisse)
    b. Conduct combined photomosaic and multibeam survey.
8) Make quantitative flux integrator collection (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement
9) Collect T and Chem data on Tahi 1. Include 4-6 ISMS measurements (Cherisse
10) Collect T and Chem data on Tahi 1P. Include 4-6 ISMS measurements
11) Revisit lines for multibeam and tighten up if needed
12) Multibeam (Sam)
    a. Collect multibeam data over the Southern area
        i. Approx 250m x 250m About 5 hrs.
    b. Collect multibeam in transit to Northern area
    c. Collect multibeam data over Northern area
13) repeat 6-10
14) Make final quantitative flux integrator collection (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement
15) Come on home

Watch Standers Report R1932

Tahi Moana
Launch: April 25, 2016, 0010
Recovery: April 26, 2016, 1031

0000 – 0400 Emily Estes
ROPOS went in the water at the start of watch and arrived at bottom at 14:08 GMT. We began by exploring the northern waypoints, taking DSC photos of the biology we encountered. We located an ALV patch at site diffuse 4, took an ISMS measurement, and then began a flux integrator measurement at that patch.
0400 – 0800 Sean Sylva
We were at diffuse venting sites at Tahi Moana. Flux integrator ISMS measurements were performed before and after an Alviniconcha collection. We also collected an orange rock for Emily.
Next we transited to the southern area while multibeaming. We encountered sedimented sheet flows and pillows. Just prior to arrive watch ended.
0400 - 1200 Arunima Sen
Watch started in the southern part of the vent field. We saw some chimneys, but they were very sparsely populated. We circled a big chimney complex that looked promising, but did not see any chemosynthesis based fauna. However, we did see a nice flange pool. We filmed an orange dumbo octopus. When Chuck returned from his Bridge meeting, he decided to bring the sub back up immediately and head to Tow Cam to capitilize on the nice weather so we ascended and ended the dive.

Dive Plan

Dive #: 1933

Date: Monday April 26th (local time/date)
Est. launch time: 1400
Estimated dive length: 24 hr

Launch LAT/LONG: -20° 19.0002, -176° 8.172

Approx. depth at bottom: 2720 meters

Name of site: Tow Cam

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Down looking Beast Cam
Strobe on swing arm
Multibeam this dive

No IGTs this dive

Standard equip.
Collection scoop
Slurp sampler
Niskins

TOOL	TAKE ON DIVE?
Snail scoops	**yes**
Nets	
Flux integrator	**yes**
Mini-flux integrator	
Markers	**Yes, 6**
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	**Yes**
Beast Cam, forward-looking	
Multibeam	**Yes**
Mass spec	**Yes**
Niskins	**4**
Suction sampler	**Yes**

Mosaic Site Names/Positions

Site	Site type	Mrkr	Add. _ mrkr	Head	Lat.	Long	Depth
TC1	Diff	31		206	-20 19.0002	-176 8.172	2706
TC2	Diff	64	J	271	-20 18.981	-176 8.187	2723
TC1C	Chim	JJ		234	-20 18.972	-176 8.1906	2720
TW					-20 19.0017	-176 8.1928	2703

Dive activities

1) Dive on TC1. Mosaick and multibeam
2) Move to TC2. Mosaick and multibeam
3) Move to TC1C. Mosaick (HD video camera)
4) Make flux integrator collection (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement
5) Look for Mini Tubeworms (collect if found)
6) Multibeam site (now if additional time is needed, or later)
7) Return to TC1 and T/chem survey
8) Make flux integrator collection (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement
9) Return to TC2 and t/chem survey
10) Return to chimney (TC1C) and T/chem survey
11) Final Alviniconcha collections and up.

Watch Standers Report R1933

Tow Cam
Launch : April 26, 2016, 15:18
Recovery : April 27, 2016, 19:10

1200 – 1600 Fanny Girard
We started to dive at 15:18 and we were still going down when my watch ended.
1600 – 2000 Jessie/Jenny
In water at 3:20 and transited to bottom at Tow Cam. Multibeam of TC1. Photo mosaic of TC1 Had to repeat TC1 mosaic due to problems. Lines of TC1 appear to be off due to vehicle asymmetry effecting forward motion, will repeat a few lines to test of stepping forward in increments helps. It appears to in one direction. Photomosaic of TC2, up until start of line 10, when Sam took over.
2000 – 0000 Sam Vohsen
We completed a mosaic at TC2 but it wasn't going well so we redid it. Then we flew to marker JJ (TC1C) and mosaicked french chimney. We then took a mass spec measurement at TC1C. Afterwards, we went looking for the Oasisia seen on the previous cruise. We found the marker and chimney where they were seen previously but we couldn't find them. Instead, we collected some Alviniconcha for Roxie. Then we headed back to TC1 to deploy the flux integrator but we couldn't find a spot so we moved on to TC2. At TC2 we took 2 mass spec measurements.
0000 – 0400 Emily Estes
Continued chemistry/temperature survey of TC2 (IS3, IS4 and T1-T16). One orange rock was collected for Emily. Then went to the TC1 site and started the temperature/chemistry survey there (IS1-IS3).
0400 – 0800 Sean Sylva
Started watch by completing the top corner of TC1 mosaic that was missing from the original pass. We then performed two ISMS measurements in the area of TC1. The rest of the watch was consumed by multibeam mapping.
0800 - 1200 Arunima Sen
Colleen was multibeaming at the start of the watch, near the TC1 site. We completed lines 26-29 and 39-50. At 20:26:18 (UTC) we opened the biobox to aerate the animals inside. Then we went to TC1 and established a peripheral site that extended out from the TC1 active site, encompassing both active and peripheral areas. Arunima and Fanny mosaicked the new site.
1200 – 1600 Fanny Girard
My watch started at the end of the multibeam transect. We mosaicked a new peripheral site (TC1P) adjacent to TC1. We then looked around the TC1 area for samples for Jessie's particulates experiment. We collected several mussels with barnacles (1933-2) as well as anemones (1933-3) on them. We also collected three basalt rocks covered with zoanthids (1933-4,5&6). Finally, we used the suction sampler to collect some shrimps (1933-7). After that, we went back to TC1 to take temperature measurements. We ended up taking 38 temperature measurements and one mass spectrometry measurement. We then went to TC1P and took 6 temperature measurements.
1600 – 2000 Jessie/Jenny
Collected multiple scoops of *Alviniconcha* for Roxie and Arunima. Collected shrimp for Jessie with suction sampler. Left bottom at 17:05. On deck at 19:10.

Dive Plan

Dive #: 1934

Date: Wend. April 27th (local time/date)
Est. launch time: 2300
Estimated dive length: 36 hr

Launch LAT/LONG: -20 40.88712, -176 10.94496
Approx. depth at bottom: 2260 meters
Name of site: Tahi Moana

Vehicle configuration

Two bioboxes
- **Swing Arm**
- **Forward platform**

Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Down- looking Beast Cam
Strobe on swing arm
Multibeam this dive

No IGTs this dive

Standard equip.
Collection scoop
Slurp sampler
Niskins

TOOL	TAKE ON DIVE?
Snail scoops	**yes**
Nets	
Flux integrator	**yes**
Mini-flux integrator	
Markers	**Yes, 6**
IGT (gastight)	
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	**Yes**
Beast Cam, forward-looking	
Multibeam	**Yes**
Mass spec	**Yes**
Niskins	**4**
Suction sampler	**Yes**

Site	Site type	Mrkr	Lat.	Long	Depth
N-Tani		X13	-20 40.4353	-176 10.80374	
N-Tani	Diffuse flow 3		-20 40.42314	-176 10.82322 -176 10.82322	
N-Tani	Diffuse flow 4		-20 40.4133	-176 10.85784 -176 10.85784	
S-Tani		X1	-20 40.90618	-176 10.96055	
S-Tani		X14	-20 40.93173	-176 10.99741	
S-Tani	Diffuse flow 1		-20 40.88712	-176 10.94496	
S-Tani	Diffuse flow 2		-20 40.902	-176 10.947	
S- Tani	Diffuse flow 5		-20 40.99848	-176 11.01468	
S- Tani	Diffuse flow 6		-20 40.98	-176 10.98384	
S- Tani	Diffuse flow 7		-20 40.93512	-176 11.01246	
S- Tani	Diffuse flow 8		-20 40.92756	-176 11.02248	
S- Tani	Diffuse flow 9		-20 40.89408	-176 10.93734	

Dive notes: This is still a new site for us and decisions will need to be made "on the fly". Decision points include when to do the site multibeam lines. We need some activity between collecting imagery for mosaic and doing the T/chem surveys of those sites (either FI collections or multibeam). We can break this up into two dives if needed. We will need at least one other dive for forward looking imaging and IGTs. The last thing done before ending the dive should be either a FI collection or a separate collection for shipboard experiments that includes Alviniconcha.

Dive activities

1) Dive on Southern area , Diffuse flow 1
2) Turn on multibeam
3) Conduct recon and identify diffuse flow, chimney, and peripheral areas for further study and sampling with digital targets.
4) Choose an area to establish long-term monitoring diffuse flow community "Tahi 1" (Cherisse)

    a. Deploy a marker.
    b. Conduct combined photomosaic and multibeam survey.

5) Choose an area to establish long-term monitoring peripheral community "Tahi 1P"
    a. Deploy a marker. (Cherisse)
    b. Conduct combined photomosaic and multibeam survey.

6) Make quantitative flux integrator collection (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement

7) Choose an area to establish long-term monitoring diffuse flow community "Tahi 2" (Cherisse)
    a. Deploy a marker.
    b. Conduct combined photomosaic and multibeam survey.

8) Choose an area to establish long-term monitoring peripheral community "Tahi 2P"
    a. Deploy a marker. (Cherisse)
    b. Conduct combined photomosaic and multibeam survey.

9) Revisit lines for multibeam and tighten up if needed

10) Multibeam (Sam)
    a. Collect multibeam data over the Southern area
        i. Approx 250m x 250m About 5 hrs.

11) Make final quantitative flux integrator collection(s) (Roxie)
    a. Image collection location with down-looking Zeus cam
    b. Place FI and make chem measurement.
    c. Remove animals from around FI
    d. Remove FI and collect all animals into bio box
    e. Image collection site
    f. Make new FI measurement

12) Evaluate time: Either start on chem and T of study sites or Come on home

Watch Standers Report R1934

Tahi Moana
Launch: April 27, 2016, 22:52
Recovery: April 28, 2016, 23:09

0000 – 0400 Arunima Sen
This part of the dive was mainly exploratory, since Tahi Moana is a new and unknown vent field for us. We were trying to find and establish 2 diffuse flow sites, 2 peripheral sites and 2 chimney sites. We visited a number of places marked as being areas of diffuse flow by other cruises, but did not have a lot of luck. However, further south from those marked locations we found some nice chimney sites that had a lot of animals on them and which could be used as mosaic sites. Then we returned to the area that Chuck had dropped a way point at in the previous Tahi Moana dive and found some good, potential diffuse flow sites.
0400 – 0800 Sean Sylva
We performed a photo mosaic at TH1 and deployed marker F19. Next we moved to TH2 and performed a photo mosaic. We then searched for a suitable peripheral site. Once found, we also performed a photo mosaic at site TH1P. There was a brief detour during mosaic TH1P to host an outreach event. We then deployed a marker, F17, at TH2P and performed a photo mosaic of the site. Multibeam was on and functioning at all mosaic sites except for two software crashes that left some gaps.
0800 – 1200
Went to F17 and did a flux over an Ifremeria and mussel patch. Animals were collected in PF4 biobox. Went to a chimney site and collected Alviniconcha for Roxie (put in SF2 biobox).
1200 – 1600 Fanny Girard
This watch started with a mass spectrometer measurement associated with *Alviniconcha* collections at one of the chimneys (R1934-3). We started a multibeam survey after the collections.
1600 – 1930 Cherisse du Preez
Arrived at TH1. Completed four mass specs. Owing to time, stopped TH1 chemistry survey and started up north (to collect and FLUX). Found an Alviniconcha patch to flux, but then decided to simply make a collection instead. A few large, dark Alviniconcha were collected and put into the PF1 biobox. Then moved to another spot with Alviniconcha and scooped some of them and put them into PF3 biobox. Then we headed back up to the surface.

Dive Plan

Dive #: R1935

Date: Saturday, April 30th (local time/date)
Est. launch time: 0700
Estimated dive length: 25 hr

Launch LAT/LONG: -20 40.88712, -176 10.94496
Approx. depth at bottom: 2260 meters
Name of site: Tahi Moana

Vehicle configuration

Two biobox
- **Forward platform**
- **Swing arm**

Flux integrator
One Temp wand plumbed for eh/pH and ISMS
Flux Integrator on swing arm
Multibeam this dive
IGTs on platform

Standard equip.
Collection scoop
Slurp sampler
Niskins

TOOL	TAKE ON DIVE?
Snail scoops	**yes**
Nets	
Flux integrator	**yes**
Mini-flux integrator	
Markers	**Yes, 2**
IGT (gastight)	**YES**
Protist traps	
SIP samplers	
Major samplers	
Hi Pressure recovery vessel	
Beast Cam, down-looking	
Beast Cam, forward-looking	
Multibeam	**Yes**
Mass spec	**Yes**
Niskins	**4**
Suction sampler	**Yes**

Site	Site type	Mrkr	Lat.	Long	Depth
N-Tani		X13	-20 40.4353	-176 10.80374	
N-Tani	Diffuse flow 3		-20 40.42314	-176 10.82322 -176 10.82322	
N-Tani	Diffuse flow 4		-20 40.4133	-176 10.85784 -176 10.85784	
S-Tani		X1	-20 40.90618	-176 10.96055	
S-Tani		X14	-20 40.93173	-176 10.99741	
S-Tani	TH1 & TH1P	F14	-20 40.93782	-176 11.01162	2233
S-Tani	TH2	F19	-20 40.93632	-176 10.9992	2232
S-Tani	TH2P	F17	-20 40.93278	-176 11.00742	2230

Dive notes: Some decisions will need to be made "on the fly" during this dive. Decision points include when to do the site multibeam lines. The last thing done before ending the dive should be a collection of Alviniconcha from the N end. We need to watch the weather closely as this collection is a priority for the dive but needs to be made shortly before the ROV leaves the sea floor. It will take about 3.5 hrs to move from where we are doing most of our work, find and make the collection in the north, and reach the surface.

Dive activities

1) Dive on Chimneys in Southern area
2) Collect IGT pair, preferably on a chimney we might mosaic.
3) Put a marker down here
4) Move to study sites and do and complete Chem surveys (about 6 more measurements, at a fuller range of T's
5) Do T surveys of all study sites.
6) Collect Ifremeria for Arunima from outside of mosaic area.
7) Image and collect a sample of the gorgonian near F14.
8) Choose a chimney to establish long-term monitoring "TH 1C"
    a. Deploy a marker.
    b. photomosaic survey.
9) Choose a chimney to establish long-term monitoring "TH 2C"
    a. Deploy a marker.
    b. photomosaic survey.
10) If time Remaining, fill in holes in S multibeam survery. If not, Try out Multibeam, during the transit to the N.
11) Leave the S end with 1hr 45 min of bottom time to go north, scoop up Alviniconcha from the same spot as last night and make a chem/T measurement

Watch Standers Report R1935

Tahi Moana
Launch: April 30, 2016, 0715
Recovery: May 1, 2016, 0214

0400 – 0800 Sean Sylva
We dove at approximately 7am after a weather delay. We next took Two IGTs, IGT4 and IGT6 with temperatures approximately 280^{o}C.
0800 – 1200 Cardinia Funganitao
Colleen was multibeaming at the start of the watch at TH1 site. Temperature measurements were also taken at TH1 (in CHIM1, CHIM2 and CHIM3). We took IGT4&6 in chimney 2. The FLUX was also deployed for scanning IS5 & IS6 but we terminated IS5 scan for the temperature did not rise. Temperature measurements (T1-T19 done during my watch) Temperature measurements has not yet finish when my watch ended.
1200 – 1600 Fanny Girard
Temperature measurements were being taken at TH1 when my watch started. We finished the temperature/chemistry survey at this site (32 temperature and 5 mass spectrometry measurements). We then moved on to TH1P, which is the peripheral site adjacent to TH1. We also finished all the temperature and chemistry measurements at this site. We ended up taking 17 temperature and 2 mass spectrometry measurements. Once done with this site, we went to TH2. We found marker 19 (TH2) very easily and took 53 temperature and 3 mass spectrometry measurements. We were going to go to the last mosaic site, TH2P, when my watch ended.
1600 – 2000 Jessie/Jenny
Finished temp profiling of TH2. Transited to MKR F17 and did temp profiling of TH2P. Did FLUX 12 near MKR F19 over a patch of BATHY and IFR. Collected corals near marker F14. Collected IFR at “go there”, close to marker F19. IFR put in PF2 biobox. Had a hard time finding IFR small enough to go into suction sampler, so gave up.
2000 – 0000 Sam Vohsen
We finished two vertical mosaics of the TH1C and TH2C chimneys. We then flew to a northern location and tested multibeam in transit which worked well. At the northern site, we did a flux integrator collection with a mass spec measurement. Winds were consistently over 30 so we collected a couple snails with the plastic scoop and a mass spec measurement. After that we left bottom at 12:15am.
0000 – 0400 Emily Estes
At the start of the dive, ROPOS finished collection of ALV for Jessie and surfaced due to windy weather. ROPOS was on deck by ~2:00.

Appendix: Maps and summary tables of personnel, sites, insitu activities, markers deployed, data and samples collected

Figure 1. Vent fields visited on the Eastern Lau Spreading Center and Valu Fa Ridge

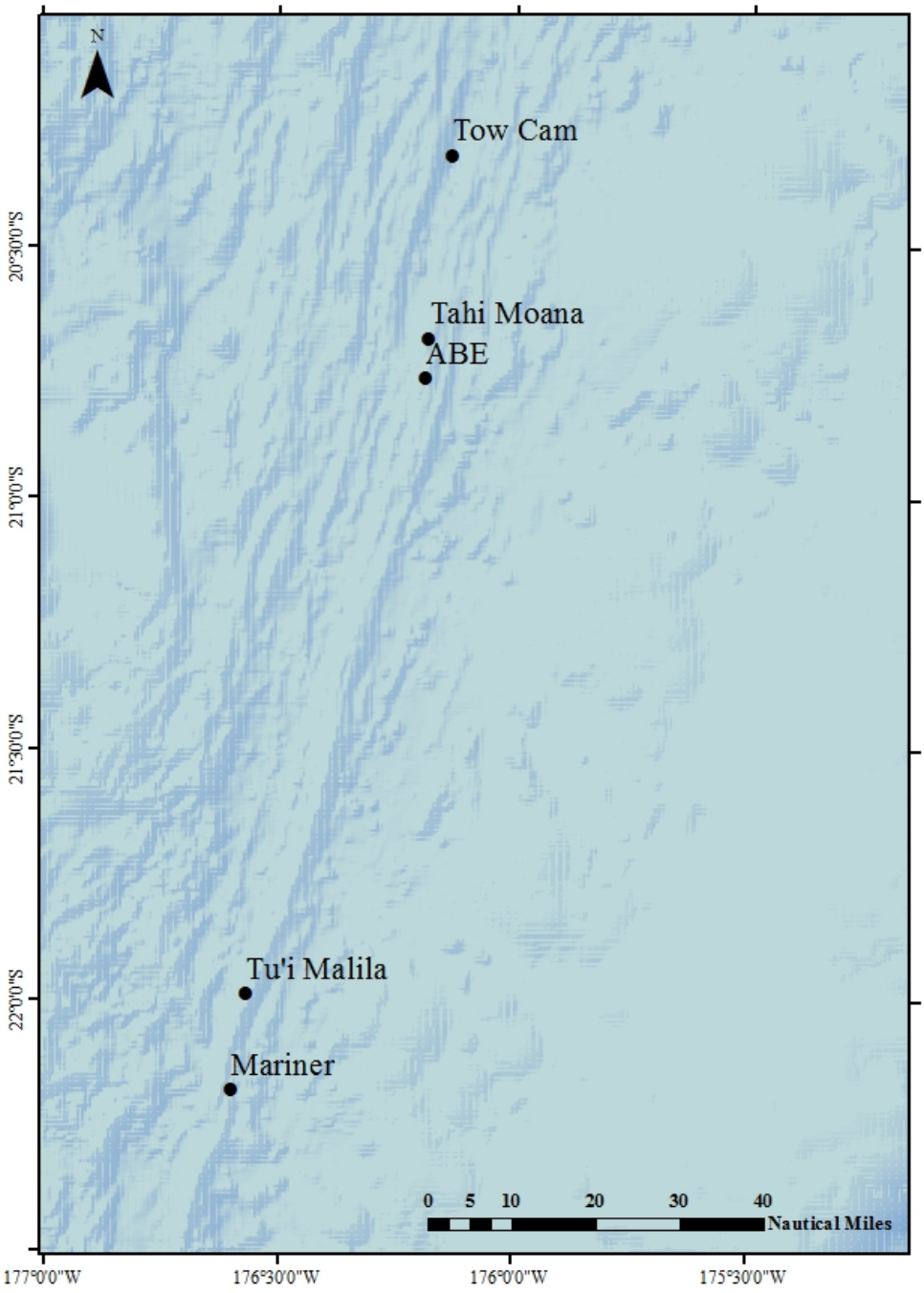


Figure 2. Study sites on the Tahi Moana vent field

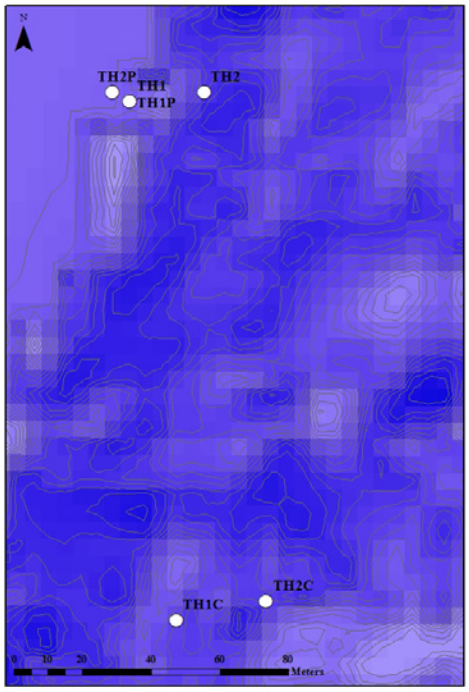


Figure 3. Study sites on the Tow Cam vent field

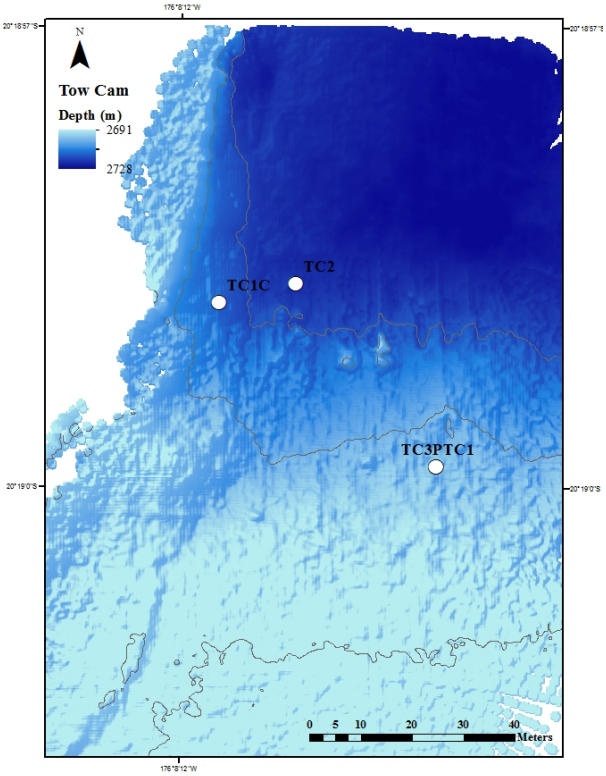


Figure 4. Study sites on the ABE vent field

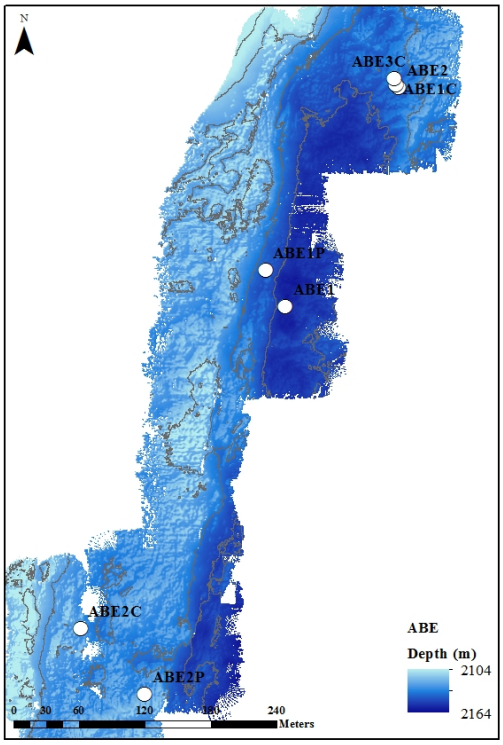


Figure 5. Study sites on the Tu'I Malila vent field

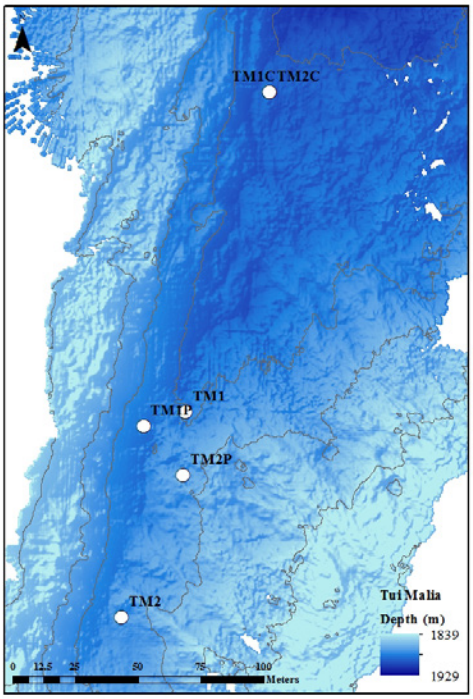


Figure 6. Study site on the Mariner vent field

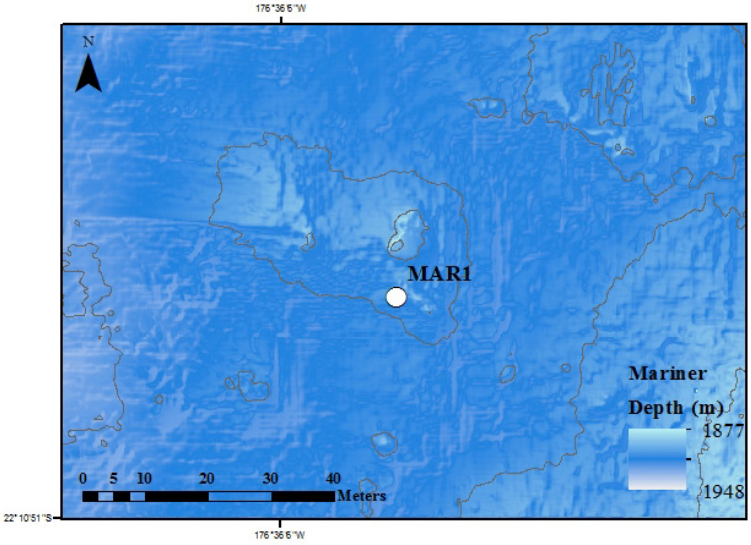


Table 1. Science Personnel

Peter Girguis	Chief Sci.	Harvard	Leg 1	pgirguis@oeb.harvard.edu
Monika Bright	Scientist	U. of Vienna	Leg 1	monika.bright@univie.ac.at
Vicki Ferrini	PI	Columbia U.	Leg 1	ferrini@ldeo.columbia.edu
Charles Fisher	Chief Sci.	Penn State	Leg 2	cfisher@psu.edu
Sam Vohsen	Grad Stu.	Penn State	Leg 2	svohsen1@gmail.com
Emily Estes	Grad Stu.	WHOI	Leg 2	emily.r.estes@gmail.com
Roxanne Beinart	PI	WHOI	Leg 1 and 2	rbeinart@yahoo.com
Sean Sylva	Technician	WHOI	Leg 1 and 2	ssylva@whoi.edu
Arunima Sen	Scientist	Arctic U. of Norway	Leg 1 and 2	borshusen@gmail.com
Jennifer Delaney	Technician	Harvard	Leg 1 and 2	jennifer.delaney@gmail.com
Jessica Panzarino	Grad Stu.	Harvard	Leg 1 and 2	jessicapanzarino@fas.harvard.edu
Fanny Girard	Grad Stu.	Penn State	Leg 1 and 2	fgirard@psu.edu
Cherisse Du Preez	PostDoc	Penn State	Leg 1 and 2	cpd4@psu.edu

Table 2. Dive Summary (dates and times are Fiji Local)

Dive number	Vent	Start date	Start time	Duration (hrs)
R1922	ABE	4-10-16	1445	44
R1923	Abort	4-13-16	1350	2
R1924	Tu'i Malila	4-13-16	1643	27.5
R1925	Abort	4-15-16	1300	4
R1926	Tu'i Malila	4-15-16	2030	27
R1927	Abort	4-21-16	0800	1
R1928	Tu'i Malila	4-21-16	1430	21.5
R1929	Mariner	4-22-16	1830	14.5
R1930	Tu'i Malila	4-23-16	1350	10
R1931	ABE	4-24-16	1220	30
R1932	Tahi Moana	4-26-16	0000	10.5
R1933	Tow Cam	4-26-16	1520	25.5
R1934	Tahi Moana	4-27-16	2330	23.5
R1935	Tahi Moana	4-30-16	0700	19

Table 3. Study Sites Mosaicked

Twenty four sites were mosaicked (seventeen previously mosaicked sites and seven new sites). All sites are located in one of five vent fields: ABE = Abe, TM = Tu'i Malila, MAR = Mariner, TC = Tow Cam, and TH = Tahi Moana. Sites ending in the letter "C" are chimney sites, "P" are peripheral sites, and no letter indicates diffuse flow sites.

Site	Lat. (D.M.dd)	Long. (D.M.dd)	Depth (m)	Heading (°)	Markers (all)
ABE1	-20 45.7914	-176 11.48568	2146	270	F11, 50, 51, 52
ABE2	-20 45.68328	-176 11.42688	2143	342	32, 34, 49
ABE1P	-20 45.77328	-176 11.4963	2135	314	F8, 46, 48, 53
ABE2P	-20 45.9828	-176 11.55869	2131	52	F10, 63, 65
ABE1C (Bugs)	-20 45.68171	-176 11.42861	2142	331	F6, G
ABE2C (Hogwarts)	-20 45.9504	-176 11.59247	2130	97	F9, AA
ABE3C (Spire)	-20 45.67872	-176 11.42921	2142	76	F7
TM1	-21 59.3472	-176 34.0938	1883	132	F4, 42, 43, 44
TM2	-21 59.39142	-176 34.1085	1880	68	35
TM1P	-21 59.3502	-176 34.10339	1880	257	F1, 38, 39, 41, 45
TM2P	-21 59.36081	-176 34.09428	1877	144	F2, 59, 60, 61
TM1C (back)	-21 59.27807	-176 34.0746	1890	339	F3, 62
TM2C (forward)	-21 59.27807	-176 34.0746	1890	78	F3, 62
MAR1 (chimney top)	-22 10.83078	-176 36.08987	1916	324	F5
TC1	-20 18.99768	-176 8.17182	2708	206	F13, 31
TC2	-20 18.97841	-176 8.18759	2723	271	F15, J, 64
TC1C (French)	-20 18.9804	-176 8.19618	2718	234	JJ
TC3P (new)	-20 18.99768	-176 8.17182	2708	206	F13
TH1 (new)	-20 40.93781	-176 11.01161	2233	180	F14
TH2 (new)	-20 40.93632	-176 10.9992	2232	285	F19
TH1P (new)	-20 40.93781	-176 11.01161	2233	180	F14
TH2P (new)	-20 40.93632	-176 11.01462	2236	262	F17
TH1C (new)	-20 41.01942	-176 11.0034	2211	245	F12, F18
TH2C (new)	-20 41.01641	-176 10.9884	2222	245	F16

Table 4. New markers deployed on the sea floor

Nineteen new markers were deployed in 2016. All markers are associated with either a previously established long-term or a new mosaic study site. Additional markers were deployed on the old sites because the 10 year old markers were often obscured with growth and very difficult to locate.

New markers	Lat. (D.M.dd)	Long. (D.M.dd)	Depth (m)
F1	-21 59.3502	-176 34.10339	1880
F2	-21 59.36081	-176 34.09428	1877
F3	-21 59.27807	-176 34.0746	1890
F4	-21 59.3472	-176 34.0938	1883
F5	-22 10.83078	-176 36.08987	1916
F6	-20 45.68171	-176 11.42861	2142
F7	-20 45.67872	-176 11.42921	2142
F8	-20 45.77328	-176 11.4963	2135
F9	-20 45.9504	-176 11.59247	2130
F10	-20 45.9828	-176 11.55869	2131
F11	-20 45.7914	-176 11.48568	2146
F12	-20 41.01588	-176 11.00388	2227
F13	-20 18.99768	-176 8.17182	2708
F14	-20 40.93781	-176 11.01161	2233
F15	-20 18.97841	-176 8.18759	2723
F16	-20 41.01641	-176 10.9884	2222
F17	-20 40.93632	-176 11.01462	2236

Table 5. Summary of IGT high temperature water samples collected.

Three pairs of high temperature water samples were collected from active chimneys. In depth analysis of these samples will be conducted in home laboratories at WHOI.

Location	**Sample #**	**Logged#**	**Lat**	**Long**	**H°**	**D**	**Max T**	**pH**
Mariner	R1929-IGT6	R1929-7	22 10.8289	176 36.0948	290	1912	340	2.77
Mariner	R1929-IGT4	R1929-8	22 10.8286	176 36.0948	291	1912	340	
Tui Malila	R1930-IGT1	R1930-1	21 59.4269	176 34.1481	248	1843	307	2.28
Tui Malila	R1930-IGT5	R1930-2	21 59.4308	176 34.1446	248	1843	295	2.37
Tahi Moana	R1935-IGT4	R1935-1	20 41.02	176 11.0028	253	2214	277	2.37
Tahi Moana	R1935-IGT6	R1935-2	20 41.0196	176 11.0026	253	2214	286	2.59

Table 6. Water samples collected for Strontium analysis requested by Tuikolongahau Halafihi of the Ministry of Fisheries, Tonga

Vent Field.	Sample #	Depth (m)	latitude	Longitude
Tui Malila	R1930-6	1876	-21° 59.3599	-176° 34.0972
Tui Malila	R1930-7	1001	-21° 59.3600	-176° 34.0973
Tui Malila	R1930-8	501	-21° 59.3601	-176° 34.0974
Tui Malila	R1930-9	49	-21° 59.3602	-176° 34.0975
ABE	R1931-2	2146	-20° 45.694	-176° 11.4372
ABE	R1931-12	1000	-20° 45.695	-176° 11.4373
ABE	R1931-13	500	-20° 45.696	-176° 11.4374
ABE	R1931-14	50	-20° 45.697	-176° 11.4375

Table 7. Near bottom (3-5 m alt) multibeam over mosaic sites.

High resolution multibeam (near-bottom; 3 to 5 m altitude) was collected over twenty of the twenty four 2016 mosaic sites, but confirmation that all data sets are of adequate quality for our analyses will occur after transfer of all data to Lamont. The four sites for which we were unable to collect multibeam were chimney sites (C). Three of the four chimneys were >10 m tall. Date and time are in coordinated universal time (UTC); mosaic site locations are degrees and decimal minutes,.

Site	Multibeam	Date	Time	Lat.	Long.	Depth (m)	Heading (°)
ABE1	Yes	10 April	15:21	-20°45.7914	-176°11.48568	2146	270
ABE2	Yes	*	*	-20°45.68328	-176°11.42688	2143	342
ABE1P	Yes	10 April	17:11	-20°45.77328	-176°11.4963	2135	314
ABE2P	Yes	10 April	12:44	-20°45.9828	-176°11.55869	2131	52
ABE1C (Bugs)	Yes	*	*	-20°45.68171	-176°11.42861	2142	331
ABE2C (Hogwarts)	Yes	*	*	-20°45.9504	-176°11.59247	2130	97
ABE3C (Spire)	Yes	*	*	-20°45.67872	-176°11.42921	2142	76
TM1	Yes	21 April	12:22	-21°59.3472	-176°34.0938	1883	132
TM2	Yes	13 April	14:40	-21°59.39142	-176°34.1085	1880	68
TM1P	Yes	13 April	12:40	-21°59.3502	-176°34.10339	1880	257
TM2P	Yes	13 April	14:10	-21°59.36081	-176°34.09428	1877	144
TM1C (back)	Yes	*	*	-21°59.27807	-176°34.0746	1890	339
TM2C (forward)	Yes	*	*	-21°59.27807	-176°34.0746	1890	78
MAR1 (chimney top)	No	-	-	-22°10.83078	-176°36.08987	1916	324
TC1	Yes	26 April	6:05	-20°18.99768	-176°8.17182	2708	206
TC2	Yes	26 April	7:30	-20°18.97841	-176°8.18759	2723	271
TC1C (French)	No	-	-	-20°18.9804	-176°8.19618	2718	234
TC3P (new)	Yes	26 April	16:02	-20°18.99768	-176°8.17182	2708	206
TH1 (new)	Yes	27 April	15:56	-20°40.93781	-176°11.01161	2233	180
TH2 (new)	Yes	27 April	16:59	-20°40.93632	-176°10.9992	2232	285
TH1P (new)	Yes	27 April	17:45	-20°40.93781	-176°11.01161	2233	180
TH2P (new)	Yes	27 April	19:32	-20°40.93632	-176°11.01462	2236	262
TH1C (new)	No	-	-	-20°41.01942	-176°11.0034	2211	245
TH2C (new)	No	-	-	-20°41.01641	-176°10.9884	2222	245

* These study sites were surveyed during the overall ROV multibeam survey of these vent fields.

Table 8. Shipboard experiments conducted by Dr. Arunima Sen.
These behavioral experiments were conducted in pressure vessels with a temperature gradient to determine the temperature preference of the dominant vent snail groups. Tissue samples from each experiment will be analyzed to determine the genes and proteins responsible for temperature detection and tolerance.

Species/Group	Experiment Type	# of replicates
Alviniconcha spp.	Heat, filtered seawater	10
Alviniconcha spp.	Heat, sulfide water	10
Alviniconcha spp.	Control, room temperature, sulfide water	5
Alviniconcha spp.	Control, cold, sulfide water	5
Alviniconcha spp.	Control, room temperature, sulfide water	5
Alviniconcha spp.	Control, cold	5
Ifremeria nautilei	Control, room temperature	3
Ifremeria nautilei	Heat, filtered seawater	3

Table 9. Flux Integrator collections. Each collection is coupled to ISMS measurements using the Flux Integrator before and after collection.

Flux ID	Site	Dive	Sample #	Dominant Animal	# inds	Lat	Lon	Depth
1	TM	1926	1926-1	IFR	71	S21° 59.3758′	W176° 34.124′	1860
2	TM	1926	1926-4	IFR	89	S21° 59.3927	W176° 34.1284′	1861
3	TM	1926	No sample #	ALV	118	S21° 59.3469′	W176° 34.0925′	1884
4	TM	1930	1930-3	ALV	51	S21° 59.3472′	W176° 34.0925′	1889
7	ABE	1931	1931-6	IFR/BATHY	70	S20° 45.7575′	W176° 11.5103′	2130
8	ABE	1931	1931-7	ALV	58	S20° 45.7'	W176° 11.5'	2130
9	THM	1932	Obs. series	ALV	66	S20° 40.4096′	W176° 10.8483′	2273
10	THM	1934	1934-1	IFR	37	S20° 40.9308′	W176° 11.0059′	2234
11	THM	1934	1934-2	IFR	29	S20° 40.9281′	W176° 11.0059′	2234
12	THM	1935	1935-3	BATHY/IFR	32	S20° 40.936′	W176° 11.0059′	2234
13	THM	1935	1935-6	ALV	12	S20° 40.4012′	W176° 10.8454′	2280

Table 10: Shipboard Experiments conducted under pressure in Girguis Pressure Van. Live vent animals and tissues were incubated under in situ pressure to examine various metabolic capabilities, rates and strategies. Experiments 1-7 tested different energy sources (sulphide and hydrogen), EJ1-5 and EJ8 examined sulphur oxidation pathways and P1 the tolerance of barnacles, zoanthids and anemones to sulphide mineral particulate exposure.

Experiment	Dive	Site	Acclimation animals #	Experimental animals #	Condition/Description
1	1922	ABE	4	8	150 uM sulfide
2	1924	Tui Malila	4	9	150 uM sulfide
3	1926	Tui Malila	6	12	150 uM sulfide
4	1928	Tui Malila	6	9	~26 uM hydrogen
5	1931	ABE	4	8	~26 uM hydrogen
6	1933	Tow Cam	0	6	No H2S/H2 control
7	1934	Tahi Moana	6	6	~26 uM hydrogen
EJ-1	1922	ABE	N/A	3	Sulfur disproportionation (low O2, sulfate-free seawater, with iron chloride as reducing agent)
EJ-2	1924	Tui Malila	N/A	3	Sulfur disproportionation (low O2, sulfate-free seawater, with iron chloride as reducing agent)
EJ-3	1926	Tui Malila	N/A	3	Sulfur disproportionation (low O2, sulfate-free seawater, with iron chloride as reducing agent)
EJ-4	1928	Tui Malila	N/A	6 (includes three t = 0 animals)	Sulfur disproportionation (low O2, sulfate-free seawater, with iron chloride as reducing agent)
EJ-5	1931	ABE	N/A	3	Sulfur disproportionation (low O2, sulfate-free seawater, with iron chloride as reducing agent)
EJ-8	1935	Tahi Moana	N/A	5	Gill incubation in glass syringes, sulfur disproportionation (low O2, sulfate-free seawater, two w/ nitrate, three w/o nitrate)
P-1	1933	Tow Cam	N/A	87	Particulate exposure experiment with barnacles, zoanthids and anemones. Total number of animals: 2 anemones, 37 barnacles, 48 Zoanthids

Table 11. In Situ Mass Spectrometer Measurements.

134 chemistry measurements were made with the mass spectrometer on the sea floor. Determination of actual concentrations of chemicals measured will be done after shore-side analysis of the data.

Dive	Site	purpose	quick name in dive notes	file name
1922	ABE	TEMP following ABE2 temp survey		1922_Apr_11_2016_04-27-42_AM
1922	ABE	TEMP following ABE2 temp survey		CANNOT LOCATE FILE
1922	ABE	TEMP near IFR during ABE1 temp survey		ABE1_30C_Apr_11_2016_09-49-28_AM
1922	ABE	AMB meas, not logged in IRLS		ABE1_backgrd_Apr_11_2016_10-00-06_AM
1922	ABE	TEMP during ABE1 temp survey, IFR/ALV border		ABE1_15_Apr_11_2016_10-03-32_AM
1922	ABE	TEMP during ABE1 temp survey		ABE1_130_Apr_11_2016_11-42-30_AM
1922	ABE	TEMP during ABE1 temp survey		ABE1_150_Apr_11_2016_11-52-00_AM
1924	TM			R1924_bckgrd_H2O_Apr_13_2016_11-09-22_AM
1924	TM	TEMP during TM1 temp survey		R1924_TM1_15C_Apr_13_2016_10-27-42_PM
1924	TM	TEMP during TM1 temp survey		R1924_30_Apr_13_2016_11-01-48_PM
1924	TM	TEMP, TM2 flange		R1924_TM2_147C_Flange_Apr_14_2016_02-07-34_AM
1924	TM	AMB, TEMP during TM2 temp survey		R1924_TM2Ambient_2.7C_Apr_14_2016_02-47-57_AM
		split into two files		R1924_TM2Ambient_2.7C_Apr_14_2016_02-54-54_AM
1924	TM	BIO collection 5, collection site a		R1924_TM1_R1924-5_50C_Apr_14_2016_05-12-05_AM
1924	TM	BIO collection, collection site b		R1924_TM1_R1924-7_17-34CApr_14_2016_06-00-12_AM
1924	TM	BIO collection, collection site c		R1924_TM1_R1924-8_19C=37C_Apr_14_2016_06-39-57_AM
1924	TM	BIO collection, collection site d		R1924_TM1_R1924-10_Apr_14_2016_07-14-16_AM
1924	TM	AMB pump test--turn off SBE pump midway through		R1924_TM1_pumptest_Apr_14_2016_07-29-17_AM
1926	TM	GENCHEM white smoker		R1926_30C_Apr_15_2016_10-21-48_AM
1926	TM	FLUX+COL pre collection measurement		R1926_flux1_Apr_15_2016_11-49-40_AM
1926	TM	FLUX+COL post clearing/collection measurement		R1926_flux1_minus_snails_Apr_15_2016_02-52-39_PM
1926	TM	TEMP near TM1C, scans 1-8 AMB pump test no SBE	TM1C_1	R1926_TM1C_Apr_15_2016_07-22-29_PM
1926	TM	TEMP near TM1C, repositioned	TM1C_2	R1926_TM1C_2_24C_Apr_15_2016_07-29-

		probe from above		54_PM
1926	TM	TEMP near TM2C		R1926_TM2C_74-98C_Apr_15_2016_09-14-00_PM
1926	TM	*near where collection made earlier?*		R1926_Flux1_9-50C_Apr_15_2016_11-50-49_PM
1926	TM	*near where collection made earlier?*		R1926_Flux1-2_Apr_16_2016_12-08-18_AM
1926	TM	FLUX+COL pre collection measurement	FLUX2B4	R1926_Flux2B4_15C_Apr_16_2016_01-05-02_AM
1926	TM	FLUX+COL post clearing/collection measurement		R1926_flux2_minus_animals_Apr_16_2016_02-45-47_AM
1926	TM	underlying crack near collection site		R1926_flux2_crack flow_Apr_16_2016_03-40-57_AM
1926	TM	Repeat of last		R1926_flux2_crack flow_Apr_16_2016_04-21-19_AM
1926	TM	AMB background		R1926_bckgrd_Apr_16_2016_05-27-45_AM
1926	TM	FLUX+COL pre collection measurement		R1926_Alv_flux1_animals_Apr_16_2016_06-48-00_AM
1926	TM	FLUX+COL post clearing/collection measurement		R1926_Alv_flux1_no_animals_Apr_16_2016_07-36-18_AM
1926	TM	FLUX+COL post clearing/collection measurement, repositioned		R1926_Alv_flux1_no_animals2_Apr_16_2016_07-50-14_AM
1928	TM	AMB measurement of seawater	TM2_IS1	r1928_TM2_Apr_21_2016_04-36-56_AM
1928	TM	flange water, dead vol test	TM2_IS2	r1928_TM2_2_Apr_21_2016_04-50-02_AM
1928	TM	TEMP chem series at TM2	TM2_IS3	r1928_TM2_3_Apr_21_2016_05-28-27_AM
1928	TM	TEMP chem series at TM2	TM2_IS4	r1928_TM2_4_Apr_21_2016_06-59-32_AM
1928	TM	TEMP chem series at TM2	TM2_IS5	r1928_TM2_5_Apr_21_2016_07-40-05_AM
1928	TM	TEMP chem series at TM1C, AMB dead vol test at start	TM1C_IS1	r1928_TM1C_1_Apr_21_2016_08-28-31_AM
1928	TM	AMB, dead vol test moving probe from vent to ambient	TM1C_IS2	r1928_TM1C_2_Apr_21_2016_08-39-05_AM
1928	TM	TEMP chem series at TM1C, AMB dead vol test at start	TM1C_IS3 = Chem2	r1928_TM1C_3_Apr_21_2016_08-48-51_AM
1928	TM	TEMP chem series at TM2C	TM2C_1 = Chem3	r1928_TM2C_1_Apr_21_2016_10-33-11_AM
1928	TM	AMB, dead vol test moving probe from vent to ambient	TM2C_2amb	r1928_TM2C_2amb_Apr_21_2016_10-41-24_AM
1928	TM	first two scans	TM2C_3 = Chem4	r1928_TM2C_2amb_Apr_21_2016_11-02-33_AM
1928	TM	TEMP chem series at TM2C, AMB dead vol test at start		r1928_TM2C_3_Apr_21_2016_11-03-30_AM
1928	TM	TEMP chem series at TM2C	TM2C_4 = Chem5	r1928_TM2C_4_Apr_21_2016_11-31-00_AM
1928	TM	TEMP chem series at TM2C	TM2C_5 = Chem6	r1928_TM2C_5_Apr_21_2016_11-54-16_AM
1928	TM	TEMP chem series at TM1, AMB dead vol test at start	TM1_1	r1928_TM1_1_Apr_21_2016_12-48-01_PM
1928	TM	AMB dead vol test moved probe out of vent	TM1_1amb	r1928_TM1_1amb_Apr_21_2016_01-00-24_PM
1928	TM	TEMP chem series at TM1, AMB dead vol test at start	TM1_2	r1928_TM1_2_Apr_21_2016_01-19-29_PM

1928	TM	TEMP chem series at TM1, AMB dead vol test at start	TM1_3	r1928_TM1C_3_Apr_21_2016_08-48-51_AM
1928	TM	TEMP chem series at TM1, FLUX	TM1_4	r1928_TM1_4_Apr_21_2016_03-00-49_PM
1928	TM	TEMP chem series at TM1, FLUX	TM1_5	r1928_TM1_5_Apr_21_2016_03-31-46_PM
1928	TM	TEMP chem series at TM1P, FLUX, AMB dead vol test	TM1P_1	r1928_TM1P_1_Apr_21_2016_04-03-37_PM
1928	TM	TEMP chem series at TM1P, FLUX	TM1P_2	r1928_TM1P_2_Apr_21_2016_04-35-43_PM
1928	TM	TEMP chem series at TM1P, FLUX	TM1P_3	R1928_TM1P_3_Apr_21_2016_05-28-12_PM
1928	TM	TEMP chem series at TM2P, FLUX	TM2P_1	R1928_TM2P_1_Apr_21_2016_06-18-57_PM
1928	TM	TEMP chem series at TM2P	TM2P_2	R1928_TM2P_2_Apr_21_2016_06-42-40_PM
1928	TM	AMB flow test		R1928_FlowTest_Apr_21_2016_07-46-33_PM
1929	Mar	GENCHEM series at Mar1	MAR1_1	R1929_Mar1_1_Apr_22_2016_09-50-13_AM
1929	Mar	GENCHEM series at Mar1	MAR1_2	R1929_Mar1_2_Apr_22_2016_10-10-14_AM
1929	Mar	IGT at Mar1		R1929_F5IGT_Apr_22_2016_07-05-26_PM
1930	TM	FLUX+COL pre collection measurement	TM1adj_1	R1930_TM1adj1_Apr_23_2016_06-31-06_AM
1930	TM	FLUX+COL post clearing measurement	TM1adj_2	R1930_TM1adj2_Apr_23_2016_07-23-46_AM
1930	TM	FLUX+COL pre collection measurement	TM1adj_3	R1930_TM1adj3_Apr_23_2016_08-09-17_AM
1930	TM	ERR ROPOS lost control	TM1adj_4	R1930_TM1adj4_Apr_23_2016_09-12-35_AM
1930	TM	ERR operator error	TM1adj_5	
1930	TM	FLUX+COL post clearing measurement	TM1adj_6	R1930_TM1adj6_Apr_23_2016_09-32-06_AM
1930	TM	GENCHEM check for sulfide	TM2P_1	R1930_TM2P_1_Apr_23_2016_10-02-20_AM
1931	ABE	GENCHEM series at ABE1C	ABE1C_IS1	R1931_ABE1C_214Tmax_Apr_24_2016_03-09-06_AM
1931	ABE	GENCHEM series at ABE1C	ABE1C_IS2	ABE1C_IS2_14.1_Apr_24_2016_03-53-16_AM
1931	ABE	TEMP series at ABE2	ABE2_IS3	ABE2_IS1_Apr_24_2016_05-58-19_AM
1931	ABE	TEMP series at ABE2	ABE2_IS4	ABE2_IS4_Apr_24_2016_06-18-29_AM
1931	ABE	TEMP series at ABE2	ABE2_IS5	ABE2_IS4_Apr_24_2016_06-18-29_AM
1931	ABE	TEMP series at ABE2	ABE2_IS6	ABE2_IS6_Apr_24_2016_07-28-13_AM
1931	ABE	AMB measurement	ABE2_IS7	ABE2_IS7_ambient_Apr_24_2016_07-40-59_AM
1931	ABE	TEMP series at ABE2 hot chimney	ABE_IS8	ABE2_IS8_chimney_Apr_24_2016_08-08-57_AM
1931	ABE	TEMP FLUX temp series at periphery	ABE1P_IS1 (ABE_IS9)	ABE2_IS9_periphery_Apr_24_2016_09-36-10_AM
1931	ABE	TEMP FLUX temp series at periphery	ABE1P_IS2	ABE1P_IS2_Apr_24_2016_10-12-16_AM
1931	ABE	TEMP FLUX temp series at	ABE1P_IS3	ABE1P_IS3_Apr_24_2016_10-46-27_AM

		periphery		
1931	ABE	TEMP series at ABE1 animal patch	ABE1_IS3	ABE1_IS3_Apr_24_2016_11-25-51_AM
1931	ABE	TEMP series at ABE1 FLUX	ABE1_IS4	ABE1_IS4_Apr_24_2016_11-55-08_AM
1931	ABE	TEMP series at ABE1 geysing hole, aborted	ABE1_IS5	ABE1_IS5_Apr_24_2016_12-16-33_PM
1931	ABE	TEMP series at ABE1 geysing hole	ABE1_IS6	ABE1_IS6_Apr_24_2016_12-22-11_PM
1931	ABE	TEMP series at ABE1 snails	ABE1_IS7	ABE1_IS7_Apr_24_2016_12-44-48_PM
1931	ABE	TEMP series at ABE2C snails	ABE2C_IS1	ABE2C_IS1_Apr_24_2016_02-18-31_PM
1931	ABE	TEMP series at ABE2C bare rock vent	ABE2C_IS2	ABE2C_IS2_Apr_24_2016_03-06-55_PM
1931	ABE	TEMP series at ABE2C seds	ABE2C_IS3	ABE2C_IS3_Apr_24_2016_03-32-48_PM
1931	ABE	TEMP series at ABE2C	ABE2C_IS4	ABE2C_IS4_Apr_24_2016_03-49-56_PM
1931	ABE	TEMP series at ABE2C	ABE2C_IS5	R1931_ABE2C_IS5_Apr_24_2016_04-34-08_PM
1931	ABE	TEMP series at ABE 2P	ABE2P_IS1	R1931_ABE2P_IS1_Apr_24_2016_05-47-15_PM
1931	ABE	TEMP series at ABE2P	ABE2P_IS2	R1931_ABE2P_5.45C_IS2_Apr_24_2016_06-44-56_PM
1931	ABE	TEMP series at ABE2P	ABE2P_IS3	R1931_ABE2P_IS3_8.2C_Apr_24_2016_07-50-29_PM
1931	ABE	FLUX+COL pre collection measurement	ABE IS FLUX7B4	R1931_ABE_ISBefore_Apr_24_2016_10-07-07_PM
1931	ABE	FLUX+COL post clearing measurement	ABE IS FLUX7AF	R1931_ABE_flux7_14C_after_Apr_25_2016_12-21-23_AM
1931	ABE	FLUX+COL pre collection measurement	ABE IS FLUX8B4	R1931_ABE_15C_flux8_before_Apr_25_2016_01-14-23_AM
1931	ABE	FLUX+COL post clearing measurement	ABE IS FLUX8AF	R1931_ABE_flux8_after_Apr_25_2016_02-28-52_AM
1931	ABE	BIO ALV collection	ABE_IS ALV	R1931_ABE_ALV_COL_Apr_25_2016_04-09-32_AM
1932	Tahi M	GENCHEM at THdiff4	TMdiff4_IS1	R1932_THdiff4_IS2_Apr_25_2016_03-57-52_PM
1932	Tahi M	GENCHEM FLUX at THdiff4	TMdiff4_IS2	R1932_THdiff4_IS1_Apr_25_2016_03-19-49_PM
1932	Tahi M	BIO FLUX after ALV collection	TMdiff4_AfterALV	R1932_TH_AfterALV_Apr_25_2016_05-28-07_PM
1932	Tahi M	GENCHEM after ALV2, after moving a rock	TM_afterALV2	R1932_TH_AfterALV_Apr_25_2016_05-28-07_PM
1933	TC	GENCHEM chimney at TC1C	TC1C_IS1	R1933_TC1C_IS1_Apr_26_2016_09-18-41_AM
1933	TC	GENCHEM	Tctubeworm_IS1	R1933_TCTW_IS1_Apr_26_2016_10-29-50_AM
1933	TC	TEMP series at TC2	TC2_IS1	R1933_TC2_IS1_Apr_26_2016_11-27-17_AM
1933	TC	TEMP series at TC2	TC2_IS2	R1933_TC2_IS2_Apr_26_2016_11-46-01_AM
1933	TC	TEMP FLUX series at TC2	TC2_IS3	R1933_TC2_IS3_Apr_26_2016_12-37-59_PM
1933	TC	TEMP series at TC2	TC2_IS4	R1933_TC2_IS4_Apr_26_2016_01-15-42_PM

1933	TC	TEMP seriest at TC2 AMB	TC2_IS5	R1933_TC2_IS5amb_Apr_26_2016_01-25-57_PM
1933	TC	TEMP series at TC2	TC2_IS6	R1933_TC2_IS6_Apr_26_2016_01-50-59_PM
1933	TC	TEMP series at TC1	TC1_IS1	R1933_TC1_IS1_Apr_26_2016_02-58-24_PM
1933	TC	TEMP FLUX series at TC1	TC1_IS2	R1933_TC1_IS2_Apr_26_2016_03-25-22_PM
1933	TC	TEMP series at TC1	TC1_IS3	R1933_TC1_IS3_Apr_26_2016_03-53-01_PM
1933	TC	TEMP series at TC1	TC1_IS4	R1933_TC1_IS4_Apr_26_2016_04-32-26_PM
1933	TC	TEMP series at TC1	TC1_IS5	R1933_TC1_IS5_Apr_26_2016_04-51-40_PM
1933	TC	TEMP series at TC1	TC1_IS6	R1933_TC1_IS6_Apr_27_2016_02-24-02_AM
1934	TH	FLUX+COL pre collection measurement	TH_FLUX10_B4	R1934_Flux10_Apr_27_2016_08-37-25_PM
1934	TH	FLUX+COL post clearing measurement	TH_FLUX10_AF	R1934_Flux11_Apr_27_2016_09-26-15_PM
1934	TH	FLUX+COL pre collection measurement	TH_FLUX11_B4	R1934_Flux11_Apr_27_2016_09-52-46_PM
1934	TH	FLUX+COL post clearing measurement	TH_FLUX11_AF	R1934_Flux11_AFT_Apr_27_2016_10-59-02_PM
1934	TH	GENCHEM		R1934_R1934-3_Apr_27_2016_11-54-16_PM
1934	TH	TEMP series TH1	TH1_IS1	R1934_TH2_IS1_Apr_28_2016_06-16-03_AM
1934	TH	TEMP series TH1	TH1_IS2	R1934_TH2_IS2_Apr_28_2016_06-30-59_AM
1934	TH	TEMP series TH1	TH1_IS3	R1934_TH2_IS3_Apr_28_2016_06-43-01_AM
1934	TH	TEMP series TH1	TH1_IS4	R1934_TH2_IS4_Apr_28_2016_06-55-14_AM
1935	TH	TEMP series TH1	TH1_IS5	R1935_TH1_IS5_Apr_29_2016_11-14-41_PM
1935	TH	TEMP series TH1 FLUX	TH1_IS6	R1935_TH1_IS6Flux_Apr_29_2016_11-34-28_PM
1935	TH	TEMP series TH1P	TH1P_IS1	R1935_TH1P_IS1_Apr_30_2016_12-59-23_AM
1935	TH	TEMP series TH1P FLUX	TH1P_IS2	R1935_TH1P_IS2_Apr_30_2016_01-23-28_AM
1935	TH	TEMP series TH2 FLUX	TH2_IS1	R1935_TH2_IS1_Apr_30_2016_02-07-12_AM
1935	TH	TEMP series TH2 FLUX	TH2_IS2	R1935_TH2_IS2_Apr_30_2016_02-32-35_AM
1935	TH	TEMP series TH2 FLUX	TH2_IS3	R1935_TH2_IS3_Apr_30_2016_03-01-30_AM
1935	TH	FLUX+COL pre collection measurement	TH_FLUX12B4	R1935_TH_FLUX12B4_Apr_30_2016_05-53-36_AM
1935	TH	FLUX+COL post clearing measurement	TH_FLUX12AF	R1935_TH_FLUX12AF_Apr_30_2016_06-50-39_AM

1935	TH	FLUX+COL pre collection measurement	TH_FLUX13B4	R1935_TH_FLUX13B4_Apr_30_2016_10-49-12_AM
1935	TH	FLUX+COL post clearing measurement	TH_FLUX13AF	R1935_TH_FLUX13AF_Apr_30_2016_11-25-32_AM
1935	TH	GENCHEM same spot as 1934-4		R1935_TH_UN_IS1_Apr_30_2016_12-06-37_PM