

AT29-04 Cruise Report

8-28 July 2015

Morehead City NC to Woods Hole MA

Participant List

Duke University Team

Cindy Van Dover (Chief Scientist)
Bernie Ball
Jamie Wagner
Abbe Labella
Phil Turner
Eli Cole
Adam Skarke (Mississippi S. University)
Jill Bourque (USGS)

University of Oregon Team

Craig Young (PI) (Leg 2)
Laurel Hiebert
Manuel Maldonado (Leg 2)
Kirstin Meyer
Caitlin Plowman
Luciana Genio
Livier Enciso
Kathryn Medina
Kera Robbins

NC State Team

Dave Eggleston (Leg 1)
Joe Zambon
Doreen McVeigh
Austin Todd (Leg 1)

SENTRY TEAM

Carl Kaiser (ExpLdr)
Mike Jakuba
Andy Billings
Sean Kelley
Kevin Kavanaugh

ALVIN TEAM

Bob Waters (ExpLdr)
Jefferson Grau
Chris Lathan
Phil Santos
Logan Driscoll
Josh Sisson
Luis Lamar (Advanced Visualization)

Atlantis

Capt Al Lunt
Chief Mate Diego Mello
2nd Mate Max Kantod
3rd Mate Rick Bean
ComET James Brennan
SSSG Katie Graver
SSSG Alison Heater
SSSG Sheldon Blackman
Bosun Ed Popowitz (Catfish)
AB Raul Martinez
AB Lance Willis
AB Jim McGill
OS Cecile Hall
Chief Eng. Chris Morgan
1st Eng JT Walsh
2nd Eng Kevin Cruse
3rd Eng Paul Ruh
Oiler Matthew Slater
Oiler Claire Kirby
Wiper Bobby Dow
Steward Carl Wood
Cook Mark Nossiter
Mess Attnd Tanzania Edwards

Alvin Dive Index

	Dive #	Date	Location	Pilot	Port	Stbd
1	4798	09 July	Blake Ridge Main	Lathan	Kaiser	Sisson
2	4799	10 July	Blake Ridge Main	Waters	Wagner	Eggleston
3	4800	12 July	Blake Ridge Main	Waters	Ball	Todd
4	4801	13 July	Cape Fear	Lathan	LaBella	Plowman
5	4802	15 July	Norfolk Canyon E	Waters	Turner	Lamar
6	4803	16 July	Norfolk Canyon W	Grau	Bourque	PIT Santos
7	4804	17 July	C-site	Lathan	Skarke	Meyer
8	4805	18 July	Pick-'em-Up Sticks	Waters	Wagner	Zambon
9	4806	19 July	C-site	Grau	Turner	Hiebert
10	4807	20 July	Baltimore Canyon	Lathan	Turner	Driscoll
11	4808	21 July	Baltimore Canyon	Waters	Young	Maldonado
12	4809	22 July	Hudson Canyon	Grau	Skarke	Lamar
13	4810	23 July	Veatch Canyon	Lathan	Turner	Plowman
14	4811	24 July	Shallop Canyon E	Waters	Genio	Enciso
15	4812	24 July	Shallop Canyon W	Waters	McVeigh	Medina
16	4813	25 July	Veatch Canyon	Grau	Skarke	Sisson
17	4814	26 July	Shallop Canyon W	Lathan	Turner	Robbins
18	4815	27 July	N England Seep 2	Waters	Turner	Lamar

Sentry Dive Index (values are estimated from graphs, not calculated)

Div e #	Date	Depth (m)	Alt (m)	T (C)	S	O ₂ (uMolar)	OBS	ORP anomaly	Mission
322	09-10 July	2140		3	28.1	295-296	0.25	yes	Plankzooka, Blake Ridge North; 5 mab, 8 h
323	10-11 July	na	na	na	na	na	na	na	Sidescan sonar; SeepC Mooring, Blake Ridge
324	12-13 July	na	na	na	na	na	na	na	Sidescan sonar; SeepC Mooring, Cape Fear
325	15-16 July	1400-1600	20	4-4.1	28.08	292-295 variable	0.2 to 0.25	Not collected	Sidescan sonar/mapping ; Norfolk Canyon; high OBS in SW region of survey, NC West
326	16-17 July	1575-1625	5	4-4.1	28.08	294-285; lows correlated with ORP anomalies	0.2-0.25 SW	2 points, N and central	SyPRID = Plankzooka, 5 mab mussels, Norfolk Canyon W
327	17-18 July	1025	5	4.4	28.1	290-293	0.2 to 0.4	Several regions of activity, western portion	SyPRID above mussels, C-site
328	18-19 July	1460-1490	5	4	28.08	293.5, 294	0.2 to 0.24	none	SyPRID Norfolk Canyon Reference Site
329	19-20 July	1048-1050	5	4.3 spikes to 4.2	28.1	292 with excursion to 295	0.2 with 0.31 strikes	none	SyPRID C-Site Reference
330	20-21 July	397-411	5 ¹ and 1.5	8-9	28.1	160-180	0.25 to 0.33	Multiple OBS hits and ORP hits	SyPRID Baltimore Canyon 1.5 and 5 m
331	21-22 July	380-390	5	8.8-9.8	28.125-28.5	160-170		none	SyPRID Baltimore Canyon Reference ²

332	23-24 July								SyPRID mussel Veatch 5 and 1.5 m
333	24-25 July								SyPRID Veatch Reference 5 and 1.5 m
334	25-26 July								N England 2
335	26-27								N England 2 Reference

¹with 15 min of 10-m-alt sample inadvertently

²samples discarded inadvertently before sorting

ORIGINS	LAT	LON
Blake Ridge	32.46	-76.22
Cape Fear	32.95	-75.96
Norfolk Canyon E & W	36.84	-74.52
Cindy's Seep	37.52	-74.15
Pick-'em-Up Sticks	37.54	-74.32
Baltimore Canyon	37.52	-74.15
Hudson Canyon	39.51	-72.44
Veatch Canyon	39.78	-69.64
Shallop Canyon	39.97	-69.24
New England 2	39.866	-69.2833

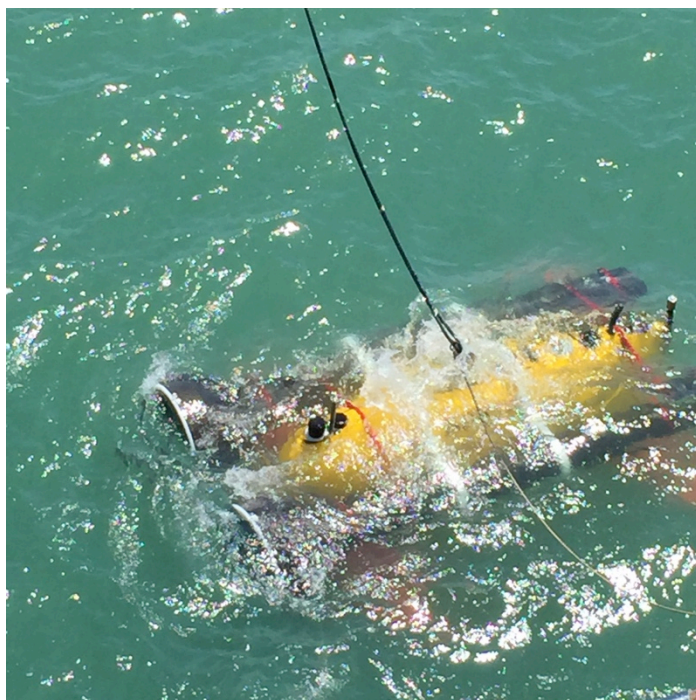
Nominal coordinates, depth for SeepC Primary Stations

SITE	LAT	LON	Z
Blake Ridge Main	32.494987	-76.190958	2163
Blake Ridge North	32.505142	-76.196501	2163
Cape Fear	32.97957	-75.92657	2598
Norfolk Canyon E	36.87119	-74.47423	1460
Norfolk Canyon W	36.86818	-74.48810	1560
Norfolk Canyon Reference	36.90082	-74.48716	1400-1500
Cindy's Site	37.54232	-74.10190	1030
Cindy's Reference Site	37.68967	-74.00149	1030
Pick-'em-up Sticks	37.57090	-74.27611	400
Baltimore Canyon	38.04857	-73.82138	400
Baltimore Canyon Reference	38.10490	-73.75330	380-390
Hudson Canyon	39.54621	-72.40311	500
Veatch Canyon	39.80504	-69.59295	1419
Shallop Canyon E	39.99523	-69.19054	316
Shallop Canyon W	39.99614	-69.12599	316
New England Seep 2	39.86933	-69.28554	1424
New England Seep 2 Reference	39.86411	-69.31449	1419

CRUISE NARRATIVE

Tuesday 7 Jul 2015.

In port dunk test of Sentry and Plankzooka.



Wednesday 8 Jul 2015.

Departed Port of Morehead City 1100h steaming to Blake Ridge site. XBTs en route.



Demonstration of Plankzooka deconstruction after sampling by Andy Billings.



ETA ~2300 h, with a plan to do a multibeam survey to reoccupy bubble plume sites for Adam Skarke before a MOCNESS shakedown lowering. EM122 MBES and 3.5 kHz sub-bottom.

Survey Line 1

32° 30.695 N 76° 12.05 W
32° 29.368 N 76° 11.271 W

Survey Line 2

32° 29.171 N 76° 11.656 W
32° 30.027 N 76° 11.305 W

Both lines should be run at 5 knots (speed over ground). The direction each line is run and the turn between them is at the discretion of the bridge.

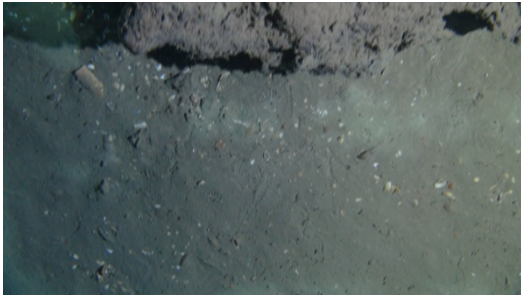
Thursday 9 Jul Blake Ridge (2163 m)

MOCNESS at Blake Ridge Main. Four samples down to ~1500 m at Blake Ridge seeps.

0800 to 1630 Alvin Dive 4798. Engineering dive at Blake Ridge Main especially to test serviced hydraulic plant, Reson sonar and new soft-grip manipulator. The hydraulic system did not work, so no manipulator capability. They did relocate the 'mystery mooring' that we had to avoid during our 2012 Sentry ops, but could not release it. Reciprocal E-W sonar runs in the same location as the 'smog' plume documented during the 2012 Sentry surveys, but with no water column data capability (requires a firmware update). Some down-looking stills (from 100MSDCF; nothing useful on 101MSDFC).



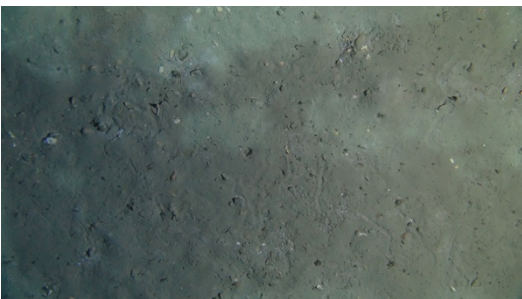
Alvin 4798. BR Main. Carbonate and *Sargassum*. 2015_07_09_14_12_18.JPG



Alvin 4798. BR Main.
2015_07_09_14_10_32.JPG



Alvin 4798. BR Main.
2015_07_09_14_10_13.JPG



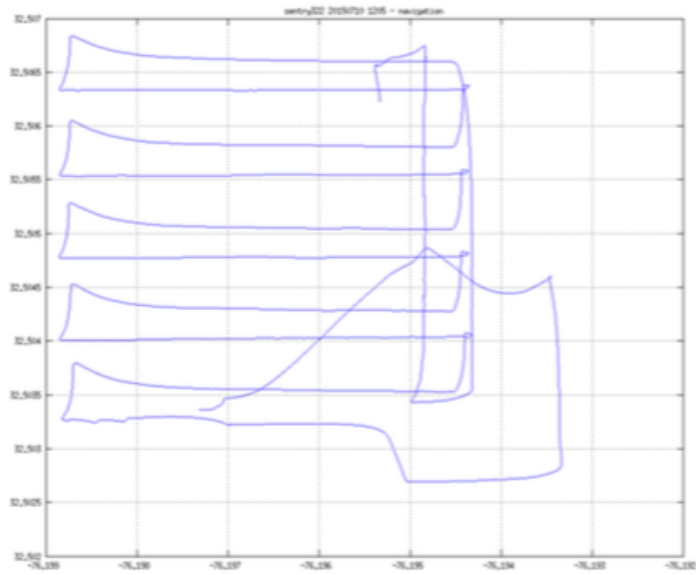
Alvin 4798
2015_07_09_14_07_01.JPG

1730 to 1845 CTD. Uneventful

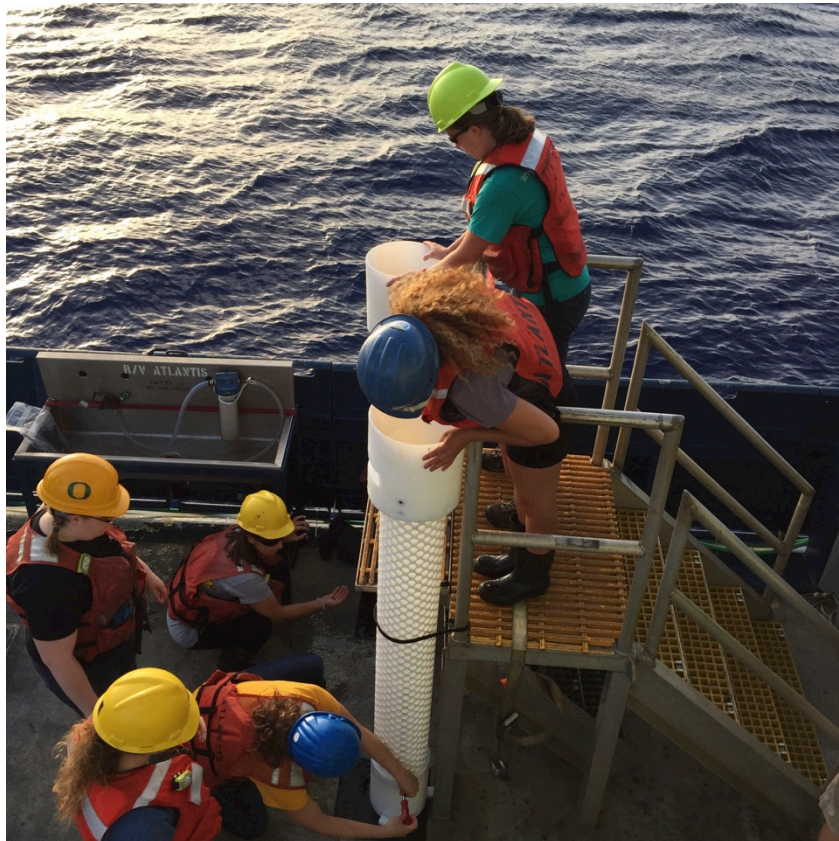
1900 SENTRY 322. First mission with Plankzooka at Blake Ridge North; nets opened at 60 mab, 8h sample at 5 mab.

Friday 10 Jul Blake Ridge (2163 m)

0630 SENTRY 322 on deck. Sample system removed and processed very efficiently by OIMB team, with report of dozens of larvae in good condition. Super Success!!!
Evidence that starboard valve did not work properly, but one subsystem worked well.



Sentry 322, Plankzooka, Blake Ridge North (5 mab)

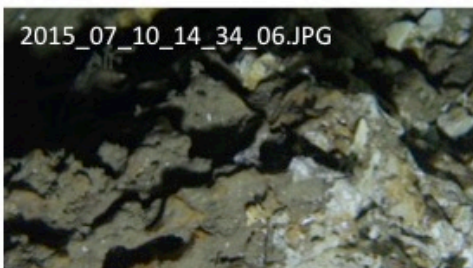
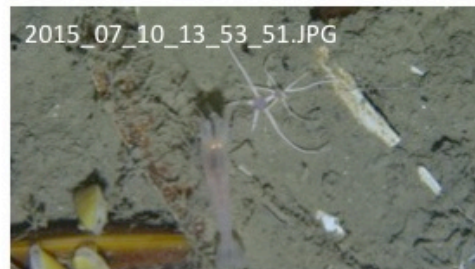


0800 Alvin Dive 4799. Blake Ridge Main (2164 m). Some issues remain with the hydraulic system (i.e. intermittent hydraulics and starboard manipulator not working) so no slurp samples; no push cores. Alvin observed clams (time: 13:51) and mussel beds

(time: 13:57) as well as bacterial and carbonate habitats. Alvin completed mussel sampling (time: 14:03) and carbonate sampling (time: 14:21) at two sites, collecting approximately 30 big mussels with an additional 40-50 small mussels. Alvin was able to locate and cut free the mystery mooring observed by Sentry in 2012. A photo transect was completed before starting a 3+-hour unsuccessful sonar scan search for the SeepC Science mooring.

1730 Alvin Dive 4799 on deck.

ALVIN 4799 Down-looking still camera





AL4799. Abbe LaBella with *Bathymodiolus heckerae*

AL4799. Carbonate sample



2100 Sentry 323. SeepC Mooring Search at Blake Ridge Seeps. 410 khz sidescan sonar, 40-45 m altitude, 100-m spacing. 1 km² search area every 3 hours.



SENTRY 323 deployment for sss survey, mooring search.

Saturday 11 July 2015 Blake Ridge

1800 Sentry 323 recovery. Multibeam was not working by sidescan sonar did work and review of the data began immediately to look for the mooring.

1930 MOCNESS deployment, Blake Ridge Main. Successful.

Sunday 12 July Blake Ridge

0300 Multibeam and Seismic Survey. Blake Ridge. Between the conclusion of the MOCNESS tow and the deployment of Alvin. Sonar data along a survey line between the following two points:

32° 30.227 N 76° 10.964 W

32° 29.226 N 76° 11.548 W.

For this survey, the ship should run up and down the line continually until it is necessary to transit to the Alvin deployment site. Slowest speed possible without the use of the bow thruster. A nominal speed of 1.5 knots is ideal but faster is acceptable if necessary to avoid using the bow thruster.

0800 Alvin 4800 Blake Ridge Main.

Alvin investigated the potential mooring target identified from Sentry's side-scan data. The target turned out to be an old shipwreck (possibly late 18th century according to Jim Delgado of the NOAA Maritime Heritage Program); one bottle was collected from the wreck (time: 14:47). Hydraulics are working so Alvin was able to collect 12 push cores; two for clams (time: 15:05), two in bacterial mats (time: 15:20), two right next to the mussels (time: 16:57), two 10m away from the mussels (time: 17:03), two 10m away from the bacterial mats (time: 18:19), two for tube worms in the sediment (18:24). A slurp sample was taken collecting ophiuroids, small mussels and shrimp (time: 16:24). 7 large mussels were also collected (time: 16:38). One of the two desired photo transects was carried out (time: 17:29 – 18:05), photos were taken on a 10 second interval at an altitude of approx. 3.94m, starting speed 0.1m/s. The area covered in the photo transect corresponds to the 'Smog Belt' explored in Alvin Dive 4798 using Reson transects.



1730 Transit to Cape Fear Seep. Multibeam and xbts enroute.

2030 Acoustic call to CF SeepC Science Mooring. Two pings but nothing else.

2100 Sentry 324. Sidescan sonar to locate Cape Fear mooring. Including a 120-m multibeam and seismic run during the Sentry lowering.

Monday 13 July 2015

0800 Sentry 324 on deck. Cape Fear. No great signals for mooring.

0900 Alvin 4801. Diving on Cape Fear seep site (2598m). Alvin investigated the potential mooring target identified via Sentry's side scan data; target was not the mooring. The remainder of the dive was spent searching for the mooring but it was not located. During the mooring search transects, Alvin dropped to the sea bed to locate live clams, but none were visible, no bacterial mats were located. No samples were taken during this dive.

1700 Alvin 4801 on deck

1730 CTD cast. Cape Fear.



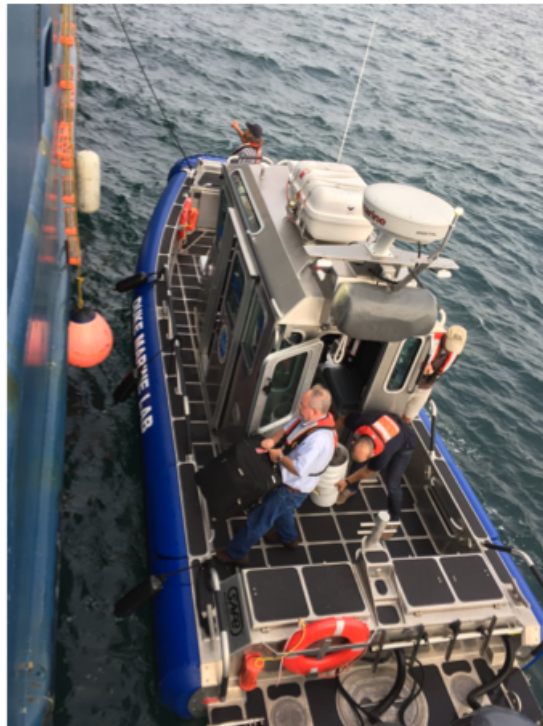
Leg 1 SeepC Science Team. Kneeling (L-R) Mike Jakuba, Caitlin Plowman, Laurel Hiebert, Doreen McVeigh, Sean Kelley; Next row (L-R): Andy Billings, Sheldon Blackman, Carl Kaiser, Kirsten Meyer, Kara Robbins, Katie Medina, Jamie Wagner, Eli Cole, Phil Turner,

Abbe LaBella, Bernie Ball, Austin Todd, Dave Eggleston, Adam Skarke. Very back row (L-R): Livier Enciso, Joe Zambon, Lucian Genio, Jill Bourque.

2100 Transit to Beaufort Sea Buoy. For personnel transfer.

Tuesday 14 July 2015

0700 personnel transfer complete. Craig Young and Manuel Maldonado on board the R/V RT Barber, Dave Eggleston and Austin Todd departed.



R/V RT Barber alongside R/V Atlantis for personnel transfer.

Transit to Norfolk Canyon. Multibeam and XBTs en route.

Wednesday 15 July

0445 CTD, Norfolk Canyon.

0800 ALVIN 4802. Norfolk Canyon East.

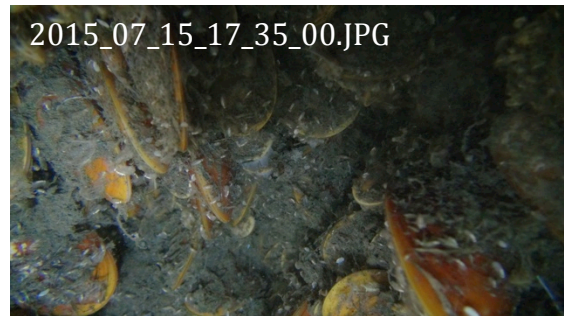
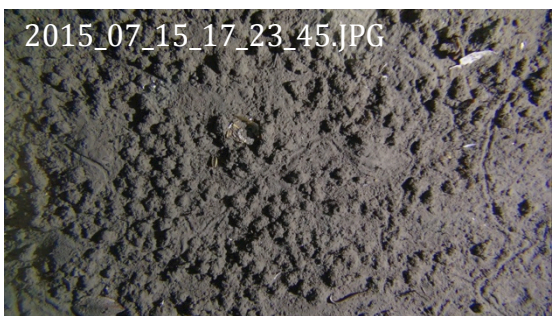
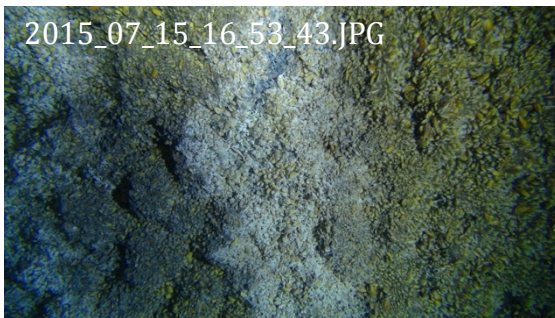
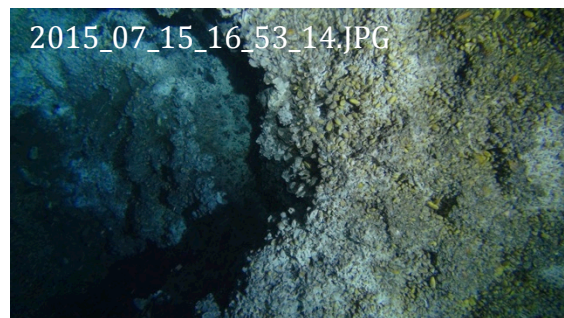
1530 ALVIN 4802 ON DECK



Luis Lamar, Phil Turner. Initiation.

AL4802. Norfolk Canyon East Seep site (1460m). Dive started 750-800 m south of the target at a depth of 1508 m. Alvin located the seep site, characterized by a large mound with a dense bed of mussels on top and less dense mussels on the slopes. Small mussels appeared to be in larger concentrations at the edge of the mound, large mussels at higher densities mid-mound. Push core samples were taken close to the edge of the mussel bed and within bacterial mats (3 pairs of each at least 10m apart, time: 14:48 – 15:38). A slurp sample was taken (time: 15:47) before sampling the mussels (time: 15:54). Alvin observed two ditches fringed by carbonate (time: 16:03); carbonate was sampled (time: 16:04). Four urchins were observed on top of the mussel bed and collected (time: 16:25 – 16:45). Three vertical 4K-camera shots were taken to provide high quality photographs characterizing the mussel bed (time: 16:14 – 16:47). A photo transect was carried out across the mussel bed for 25m. The edge of the main mussel bed was then reached, so Alvin transited 5m starboard before running approximately 30m back over the mussel bed (time: 16:56 – 17:04). The remainder of the dive was spent capturing video footage of seep taxa using the 4K-camera. Footage includes: fish,

urchin, anemone, crab, wider landscape footage as well as close-up mussel footage (time: 17:04 – 17:59).



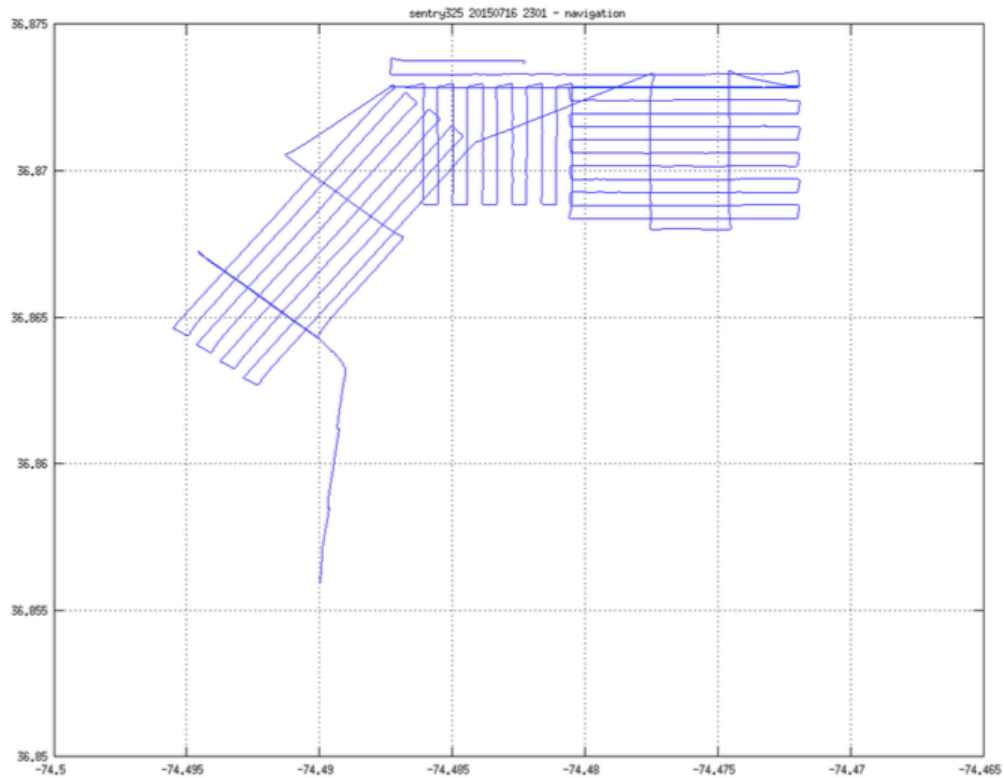
AL4802 Norfolk Canyon East. Note amphipods, lower right.

1700 Sentry 325. Norfolk Canyon East and West multibeam and sides scan sonar.

2100 MOCNESS over Norfolk Canyon East.

Thursday 16 July 2015

0700 Sentry 325 on deck



Sentry 325 Norfolk Canyon W and E; side-scan sonar and multibeam coverage (20 mab)



Picking organisms off the carbonate sample from AL4802. L-R: Phil Turner, Craig Young, Doreen McVeigh, Abbe LaBella, Jamie Wagner.

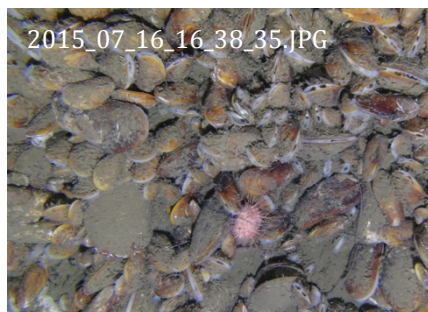
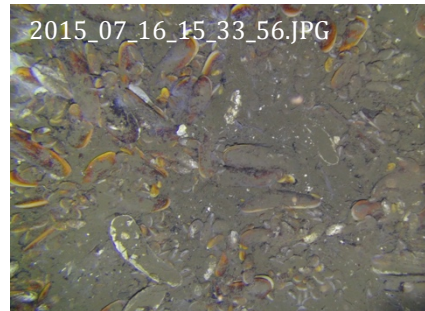
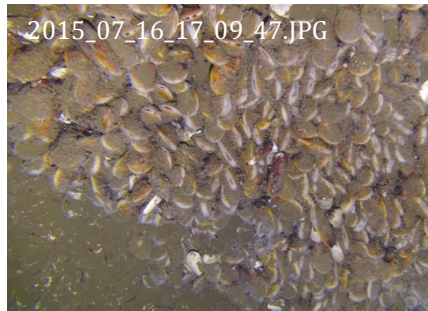
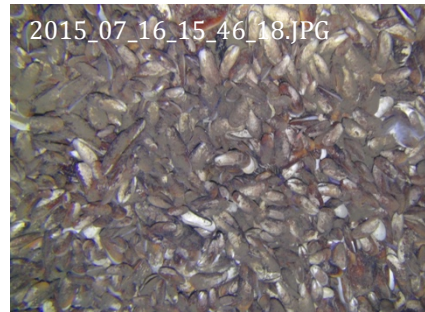
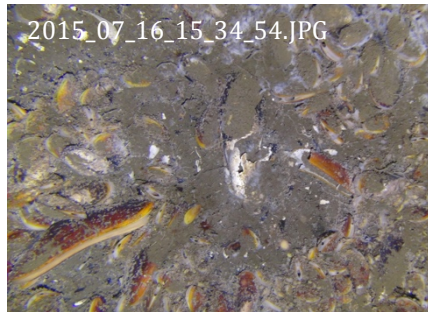
0800 Alvin 4803, Norfolk Canyon West

1700 Alvin 4803 on surface

Alvin 4803. Norfolk Canyon West (1600m). Dive started ~30m south of T1 (target 1) at a depth of 1610m. The site had a small bacterial mat, fish crabs, and carbonate but no mussels, so Alvin proceeded to T2. Two push cores (from bacterial mats) and some 4k video of a mussel patch were taken en route. Lots of shell hash was observed at T2; Alvin moved on to T3, where there was shell hash interspersed with live mussels and bacterial mats over a carbonate base. A video transect (~75m) was taken between T3 and T4. At T4 there were patches of live mussels; urchins, mussels, and holothurians were collected, in addition to three push cores. An active plume was observed at T5, along with live mussel beds. After slurping among the mussels, Alvin proceeded to T8 (high relief area) where more live mussel beds were found. A carbonate sample was taken before heading to T10 (high relief area), where large carbonate slabs and more active plumes were observed. Ophiuroids were collected before transiting to T9. Two push cores were taken and filamentous mats were observed. Alvin transited to T6, where large mussel beds were found on an incline; an urchin was sampled.



Alvin 4803, Norfolk Canyon West. CLAMS! *Echinus affinus*, *Chiridota*

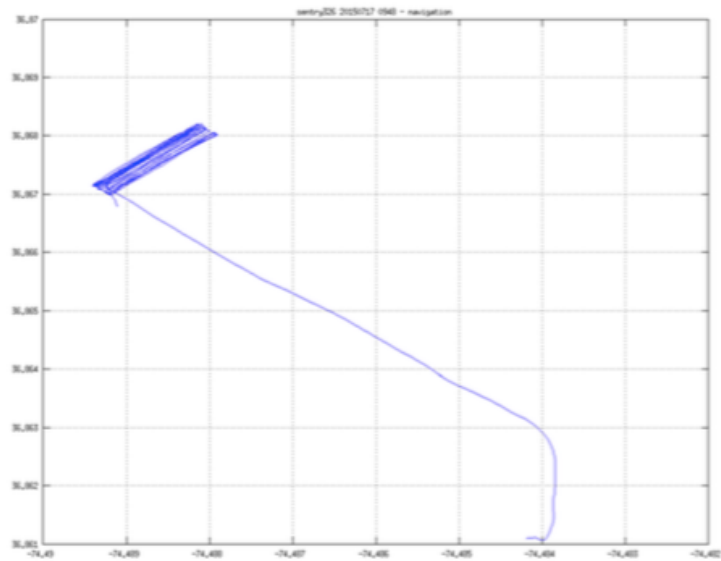


Alvin 4803, Norfolk Canyon West. *B. heckerae* and *B. childressi*???

1900 Sentry 326 with SyPRID. 5-m above mussels/seep at Norfolk Canyon West.

Friday 17 July 2015

0300 Sentry 326 recovery. Craig Young says “best deep-sea plankton samples he’s ever seen!” (not a verbatim quote) That’s saying something!



Sentry 326, Norfolk Canyon W seep 5 mab



Sentry with SyPRIDs on deck after 326; Alvin heading into dive 4804.



OIMB Larval Sorting Team working on Sentry SyPRID sample. L-R: Laurel Hiebert, Craig Young, Kara Robbins, Livier Enciso, Luciana Genio, Katie Medina, Caitlin Plowman

0400 transit to Cindy's site (xbts)

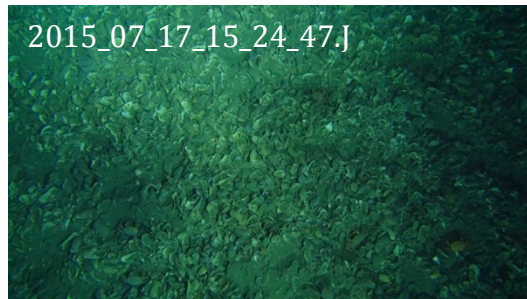
0900 Alvin 4804, Cindy's Site



Sentry after 326 deployment, with Alvin launch at C-Site

1545 ALVIN 4804 on deck

Cindy's site (1047m). Extensive relief characterizes the site with steep ridges ranging from approximately 10-15m high. The ridges are covered in mussels and it remains unclear if they are made of carbonate. Effusive gas venting was observed (time: 14:18, 16:20) and during the course of the observation venting stopped and re-started. A slurp sample was taken (time: 15:30) and mussels were sampled at three different sites (time: 14:28, 15:55 and 16:22). Carbonate rock was sampled (time: 15:40) as well as 3 crab specimens (time: 14:39, 16:24). Two push cores were taken in a bacterial mat (time: 18:02) but no other push cores were taken due to the density of the mussels and shell hash. A photo transect was carried out across the site (time: 15:10 – 15:26).



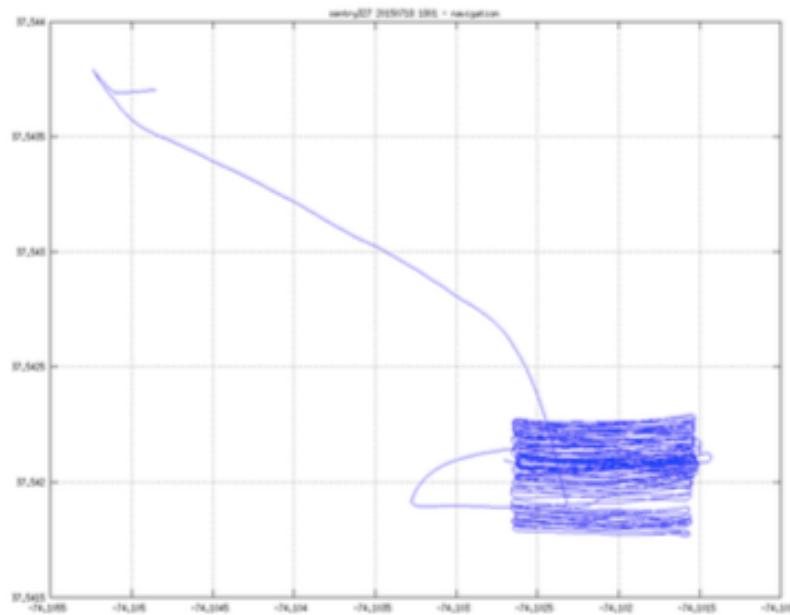
AL4804 Cindy's Site (1065 M)

1730 Sentry 327/Syprid C Site, over mussels (5 mab).

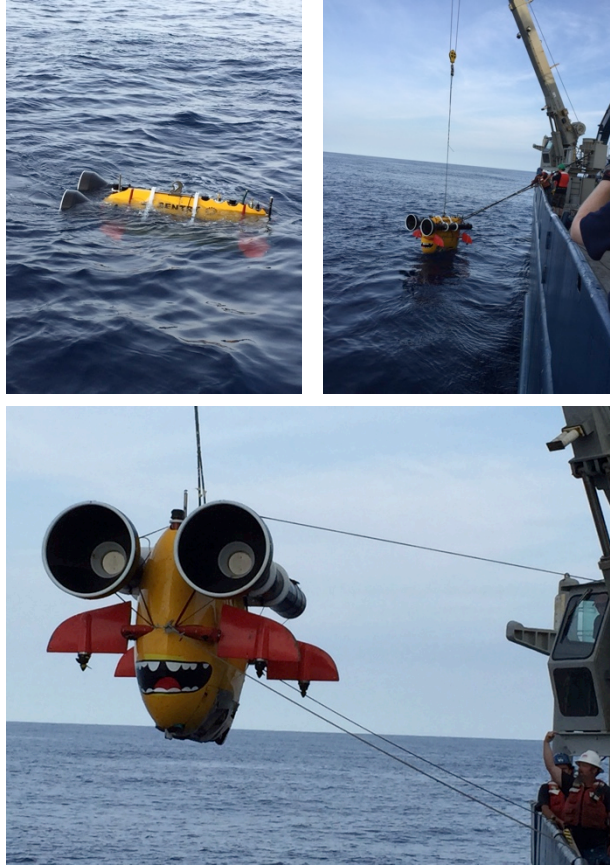
2300 CTD, C Site.

Saturday 18 July 2015

0700 Sentry 327 /SyPRID recovery, with glamour shots by Luis Lamar.



Sentry 327 Cindy's Site 5 mab mussels



0730 Transit to Pick-'em-Up Sticks

0900 AL4805 Launch Pick-'em-Up Sticks (400 m)

1700 AL4805 on deck

Pick 'em up sticks (aka Onuphid worm) site (417m). Alvin was unable to locate the original carbonate platform observed in the Okeanos Explorer engineering dive video (dive code: EX1302, date: May 31st 2013). At the initial target site numerous fauna were observed including: krill, crabs, large shrimp, anemones, fish, squid and sharks. No urchins but an abundance of other non-seep fauna. The Onuphid worms were also observed in abundance. After following the 417m-depth contour outcrops of carbonates were observed (time: 15:36, 15:50); some looked like pillars and sponges (Family: Ascidians) were sampled from the carbonate (time: 15:50). There was no evidence of a seep community, the only observation being a small amount of shell hash (time: 17:43). A slurp sample was taken to collect the Onuphid worms (time: 16:19). Video footage of active bubbling was obtained (time: 17:43, 17:59) but no mussels were observed. Alvin sampled anemones (time: 18:38, 19:06), sponges (time: 18:07, 19:06), one crab (time: 18:35) and 2 push cores (time: 19:14). The push cores were only shallow, potentially due to carbonate located under the sediment. A video transect was carried out across the carbonate mounds (time: 18:55).



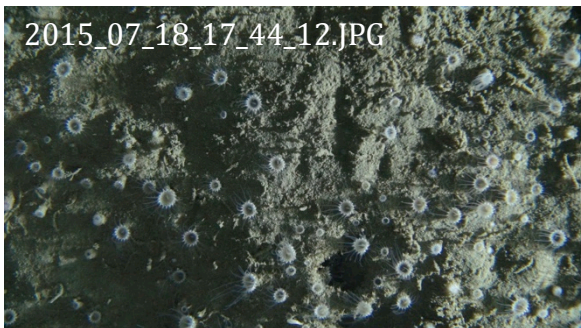
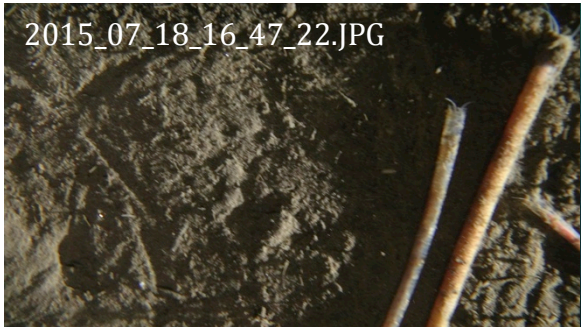
Abbe LaBella, Phil Turner and pick-'em-up sticks



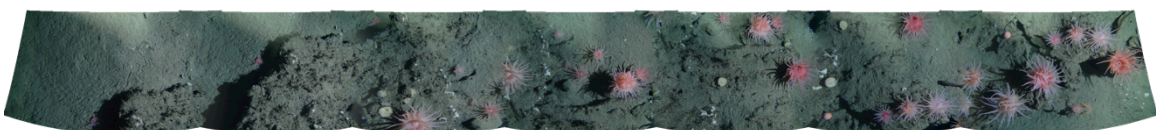
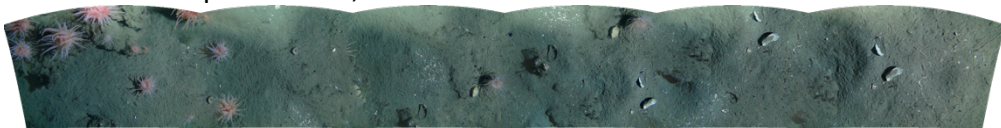
The eponymous pick-'em-up sticks. *Hyalinoecia artifex*



Commensal amphipod



Munida iris = squat lobster; *Bolocera tuediae* = anemones



2015_07_18_19_28_43 - 2015_07_18_19_30_04.tif Eli Cole

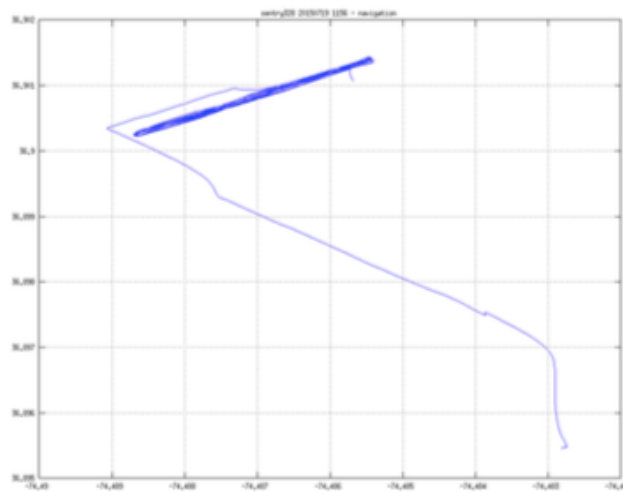
1700 transit to Norfolk Canyon Reference Site, xbts

36.900822 -74.487163

2100 Sentry 328/Syprid 5 mab Norfolk Canyon Reference Site.

SUNDAY 19 July 2015

0630 Sentry 328/Syprid recovery



Sentry 328/SyPRID Norfolk Canyon Reference Site 5 mab

0700 Transit

1100 Alvin 4806, Cindy's Site

1700 Alvin 4806 on surface

Cindy's Site (1031m). Alvin surveyed the bottom target but the area was characterized by soft sediment with small amounts of shell hash. Crabs and Rays were observed, but no live mussel communities. Alvin headed south to the 'effusive vent' and carbonate sampling targets. Travelling up slope, shell hash density increased and led into live mussel beds. Alvin stopped to observe an octopus in a large carbonate outcrop (time: 16:56) whilst sampling mussels at this site (time: 16:59). Rays, zoarcid fish and brachyuran crabs were observed in abundance; no urchins or anemones were observed. A carbonate sample was taken from the same site (time: 17:27). Alvin approached the top of a large mound (time: 17:34) with dense mussels and bacterial mats over the mussel. Bubbling was observed on top of the mound and filmed with the 4K Camera (time: 17:42). Away from the ~10m mound, a short photo transect was carried out

(time: 18:01). Additional Carbonate outcrops were located, video of potential sponges was obtained and the carbonate was sampled (time: 18:26). Around the edge of the mound a series of core samples were taken near mussels (time: 18:45, 19:47, 19:57). 4K video footage was taken of an area of active bubbling and methane hydrate (time:19:02). An area of bacterial mat was also sampled with cores near the methane hydrate (time: 19:19). The remainder of the dive was spent recording bubbling from underneath the mussels on top of the carbonate platform (20:07), as well as the carbonate cliff edge (time: 20:09).



ALVIN 4806. 2015_07_19_18_36_45.JPG



Alvin 4806; mating crabs, top right

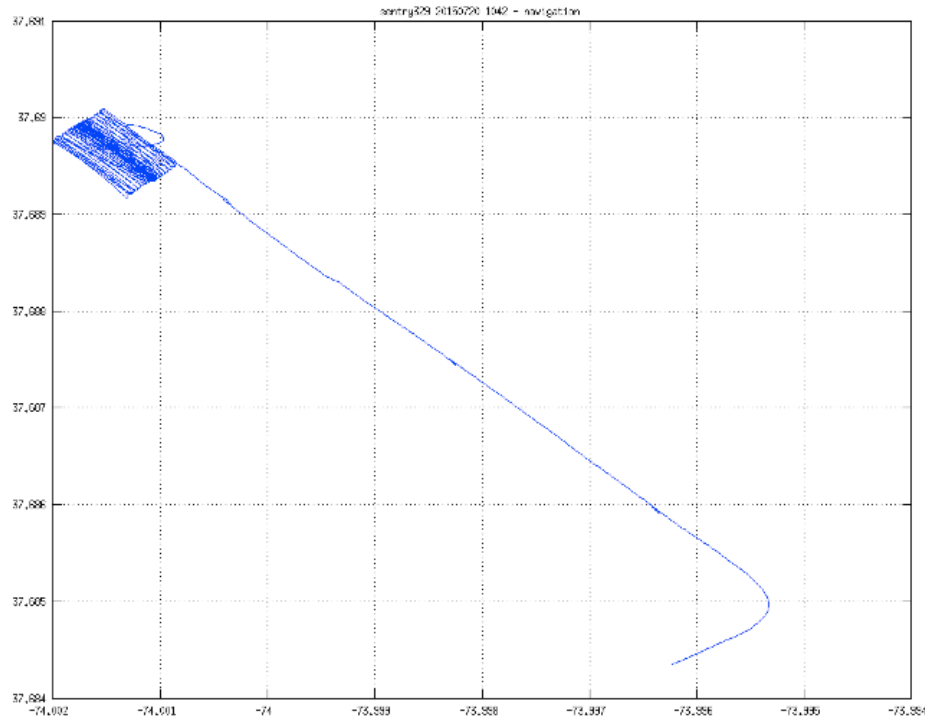
1730 Seismic Survey, Cindy's Site

1930? Transit, Cindy's Site Reference Area

2030 Sentry 329/SyPRID Cindy's Reference Site, 5 mab

Monday 20 July 2015

0700 Sentry 329/SyPRID Cindy's Reference Site on deck, samples secure



Sentry/SyPRID 329 Cindy's Site Reference alt 5 m

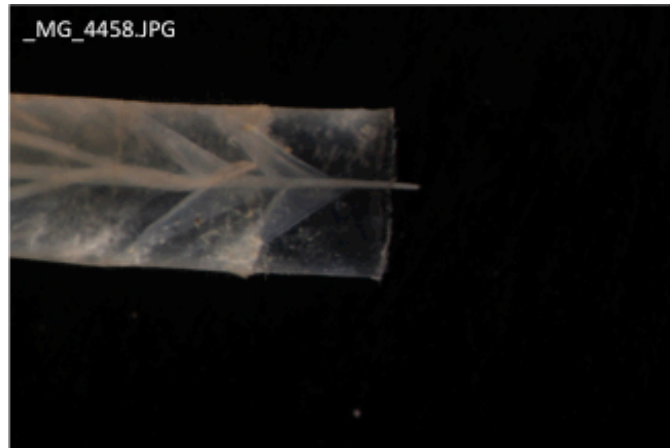
0700 Transit to Baltimore Canyon seeps

1100 Alvin 4807, Baltimore Canyon (500 m)

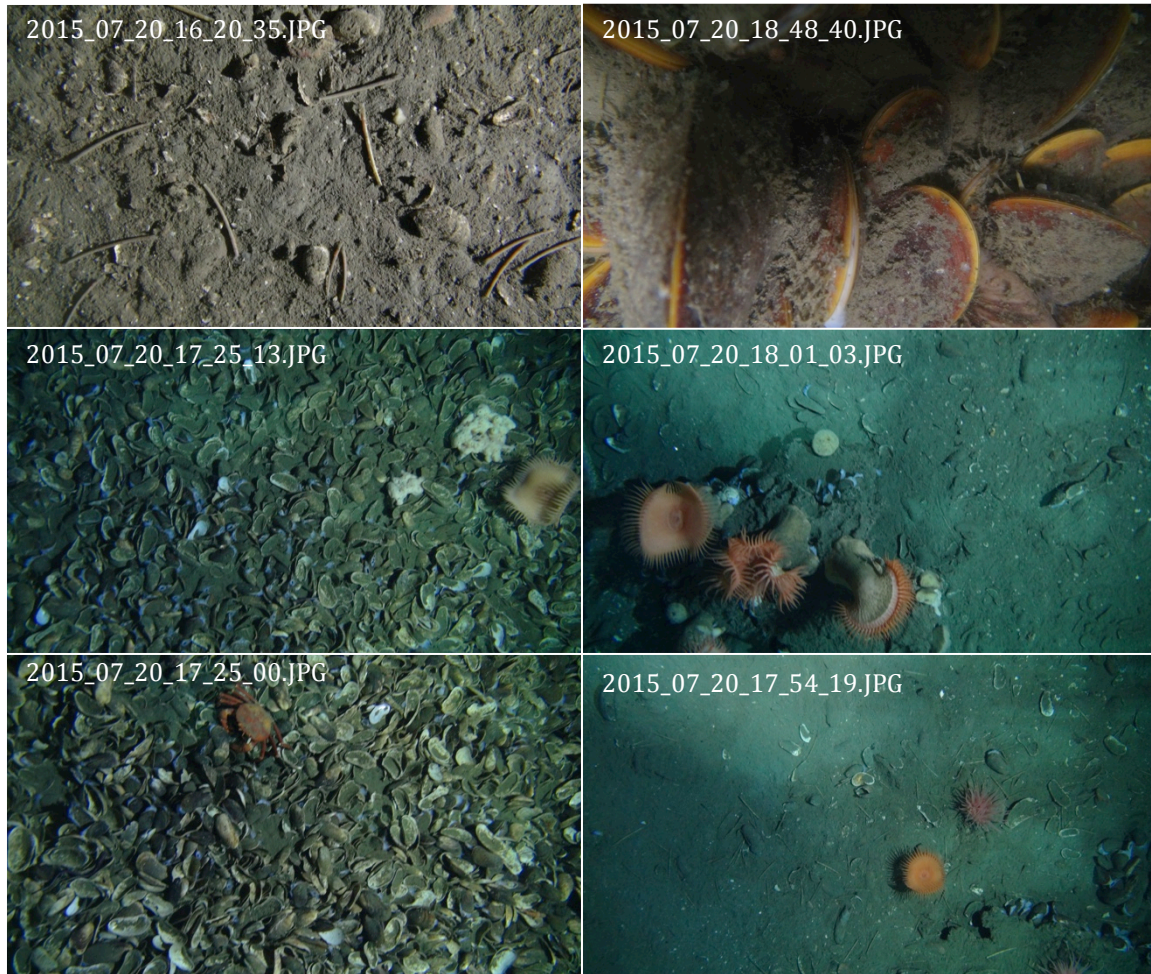
Baltimore Canyon (406m). Started 400m west of target 1 near a marked seep site; dense shell hash and carbonate outcrops were observed. Alvin sampled a small collection of Onuphid worms and filmed them moving (time: 16:42). Transiting towards main mussel bed targets, Alvin observed a dense mussel bed 100m south of target 9 near a marked seep target (time: 17:17). Numerous Venus flytrap anemones and other anemones were observed along with crabs, hermit crabs, starfish, zoarcid fish, krill and Onuphid worms. A photo transect was carried out moving north, starting 50m East of target 9 towards target 4 (time: 17:30 – 17:55). A slurp sample was taken (time: 18:09) before sampling mussels and carbonate at target 3 (time: 18:22). Shrimp and gastropods were observed between the mussels (time: 18:46). Dense patches of bacterial mat were not observed in the area. Alvin continued north to target 4 encountering a 30 degree

slope with active bubbling at the top. Dense mussel beds covered the slope and ridge top (time: 19:15). Two sets of push cores were taken at the edge of the target 4-mussel bed (time: 19:39, 20:09).

1730 Alvin 4807 on deck



Hyalinoecia artifex, Baltimore Canyon



Alvin 4807 Baltimore Canyon

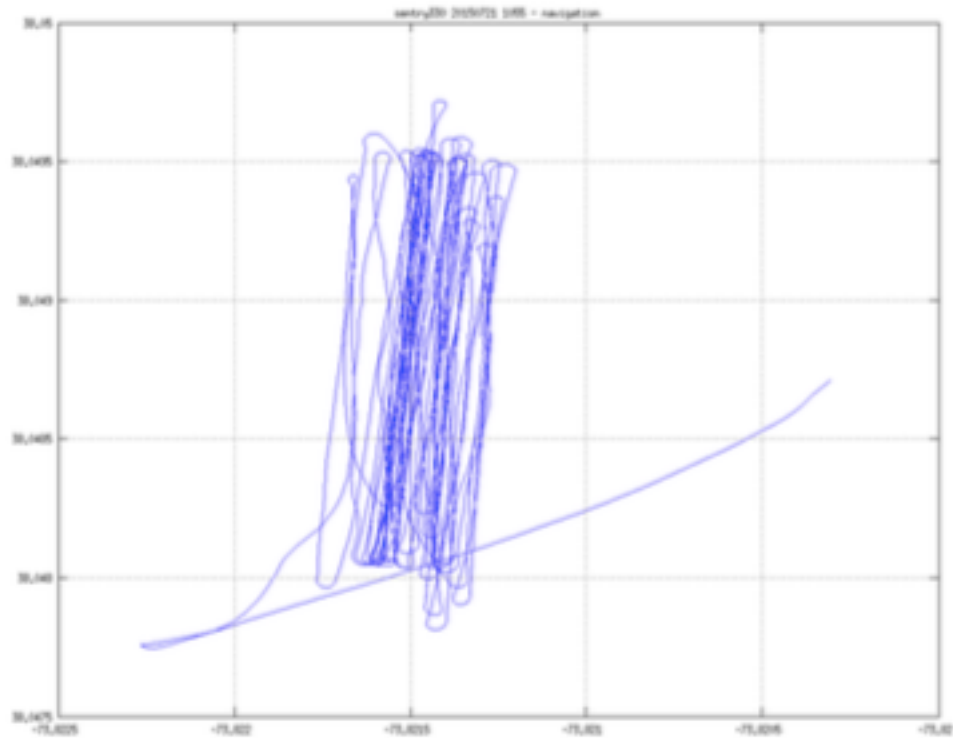
1830 Sentry/SyPRID 330 Baltimore Canyon (500 m); 5 m alt and 1.5 m alt single barrel samples

2100 CTD Baltimore Canyon

Tuesday 20 July 2015

0700 Sentry/SyPRID 330 secure

This was the sixth SyPRID sampler dive of the cruise. It was over a known mussel bed in Baltimore Canyon. **For the first time, the two SyPRIDs were used independently** with one being used at a nominal altitude of 5m and the second used at a nominal altitude of 2.5m. The launch, descent and initial portion of the dive went as planned. Due to a communication error, the vehicle briefly rose to 10m during the nominal 5m sample. This was approximately 15minutes in duration. The remainder of the dive went as planned.



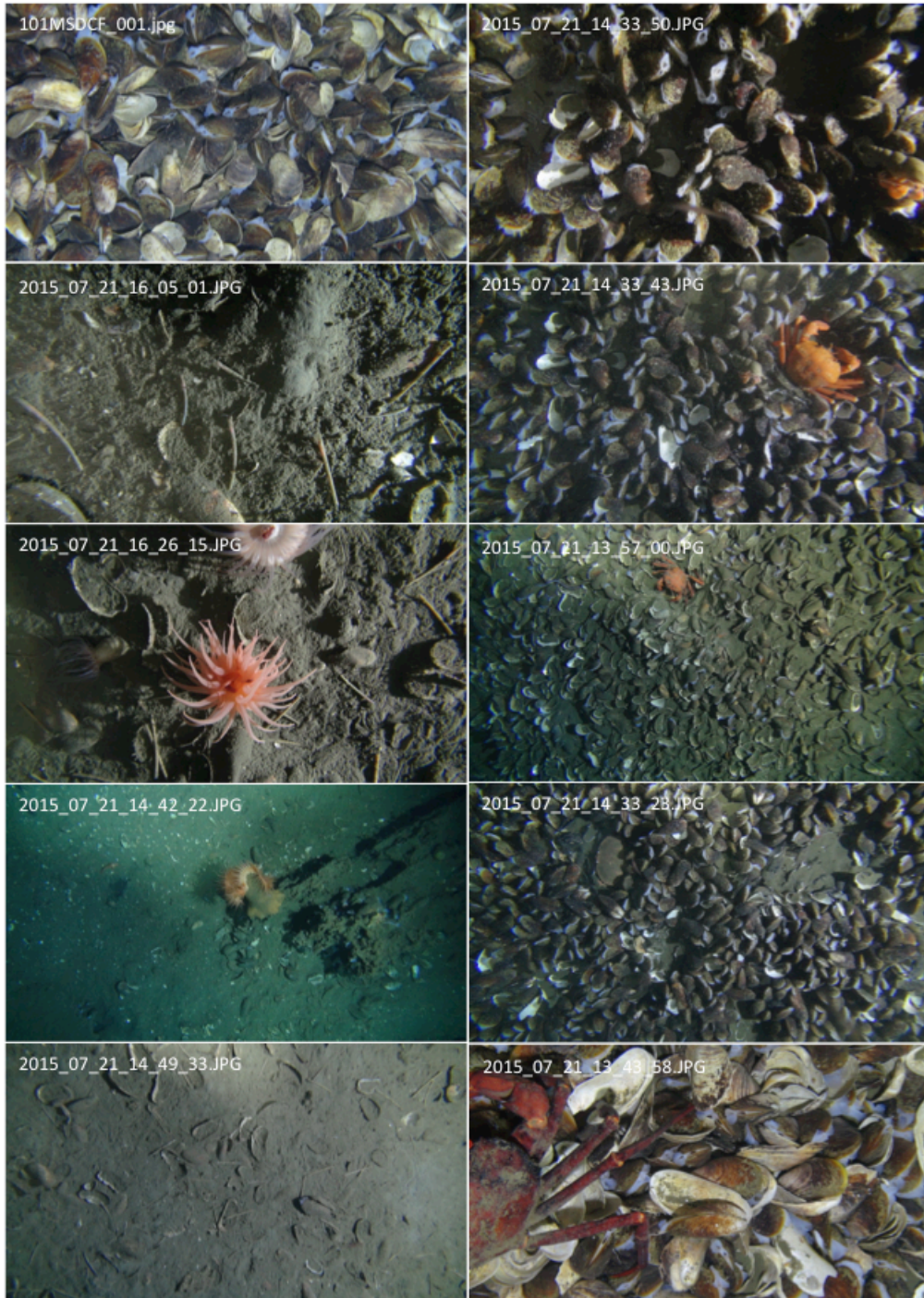
0800 ALVIN 4808 (Baltimore Canyon, 400 m)

recovery for ground; quick turn-around and relaunch

1600 Alvin 4808 secure

Baltimore Canyon (393m). Deployment had to be re-started following an issue with grounding; second launch at 8:55am. Once on-bottom Alvin observed an 18.5-degree slope and carried out a photo transect over the mussel bed until it gave way to shell hash (time: 13:54); the transect was repeated in the opposite direction. 4K video footage was taken of crabs feeding (time: 14:25) and active bubbling at the mussel bed (time: 14:36). Alvin transited north from the mussel bed towards the sponge targets, attempting to observe Onuphids. Most of the Onuphids were dead but some live Onuphids were observed (time: 14:45). 4K footage was taken of a flytrap anemone (time: 14:51), as well as small sponges on carbonate outcrops (time: 15:14). Alvin sampled the carbonate that contained sponges (time: 15:18) as well as two cushion sea stars (time: 15:29, 16:10), a white spherical sponges (time: 15:35), a white sea star (time: 16:22) and large mussels for spawning (time: 16:49). 3 pairs of push cores were completed, 2 in bacterial mats (time: 16:39, 17:10) and 1 pair near the mussel bed

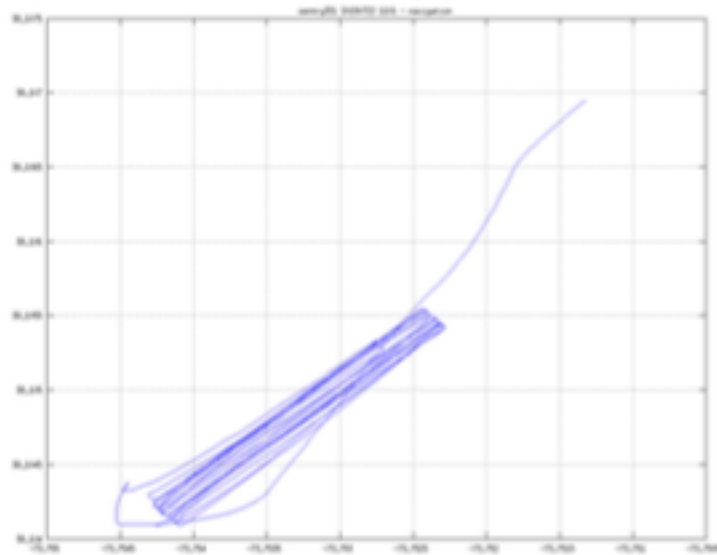
(time: 17:04). A slurp sample was taken to sample more Onuphid worms (time: 17:26), as well as around a sponge (time: 17:54).



1630 Sentry/SyPRID 331 Launch, Baltimore Canyon reference

1130 Sentry/SyPRID 331 on deck

Samples inadvertently thrown overboard before they were processed.



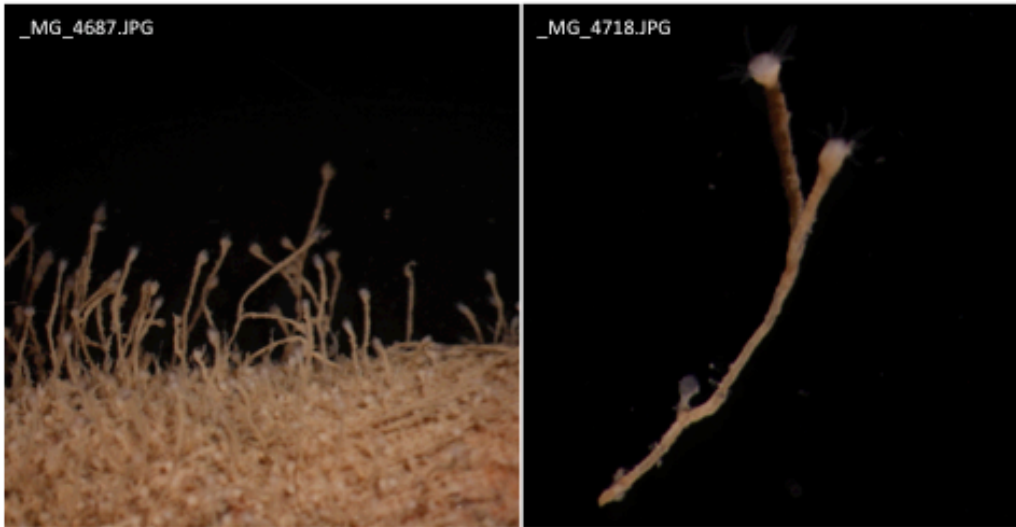
Sentry 331 Baltimore Canyon Reference

0000 Transit to Hudson Canyon. XBTs, MB Survey along margin.

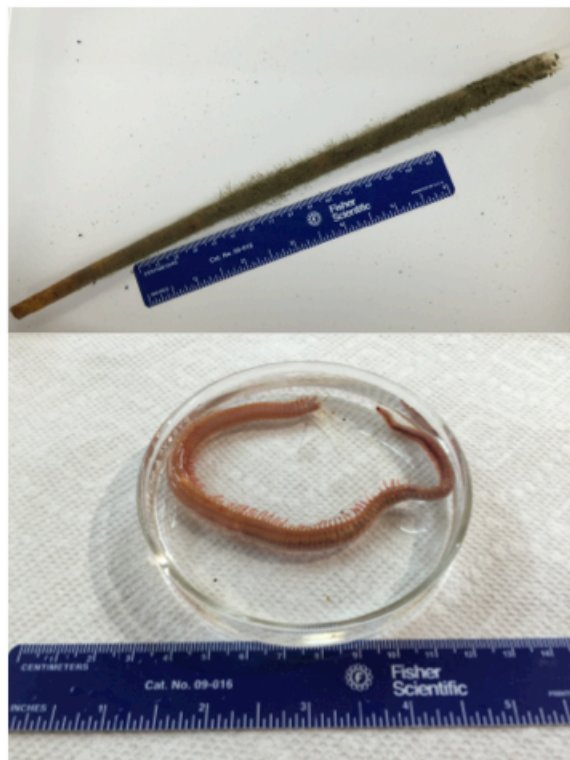
1130 Alvin 4809 Launch, Hudson Canyon

1700 Alvin 4810 recovery

Hudson Canyon (520m). Alvin experienced poor visibility within the canyon; currents traveling down the canyon caused high turbidity. Alvin investigated 5 of 7 targets but did not locate any mussel communities or active bubbling sites. The site was characterized by soft sediment; holes were observed within the sediment between target 2 and 3 but no bubbling. Alvin sampled 4 large Onuphid worms (approx. 15-20cm; time: 18:05-19:32). 4K video footage was obtained for anemones (time: 16:32, 17:22), onuphid worms (time: 18:09) as well as a sponge and brittle star (time: 20:26).



AL4809 Hudson Canyon hydroids on giant onuphid tube



AL4809 Hudson Canyon giant onuphid

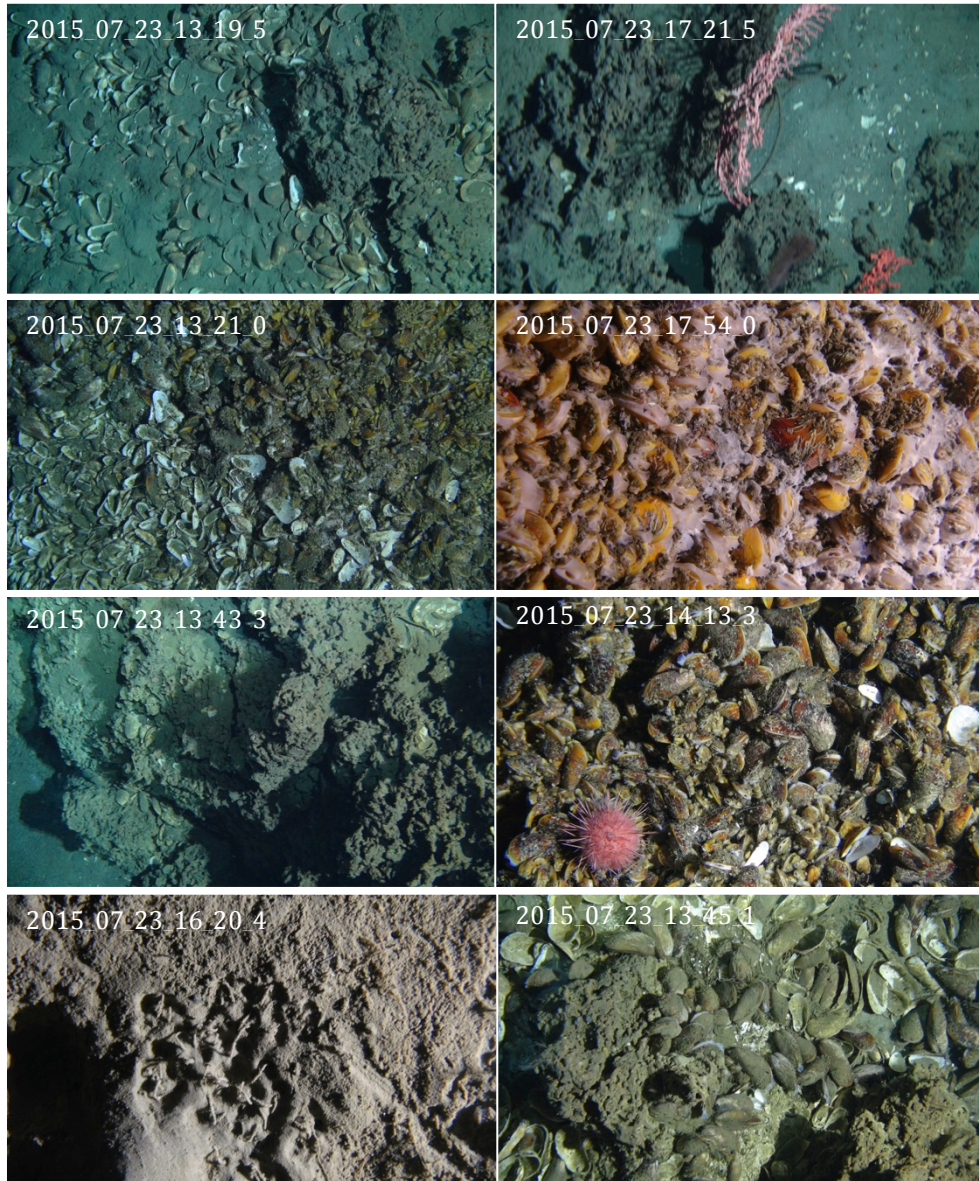
1730 Transit to Veatch Canyon; xbts, multibeam

Thursday 23 July

0800 Alvin 4810 Veatch Canyon

Veatch Canyon (4810m). Once on-bottom Alvin headed east towards Target 1. Within the water column numerous sea pigs were observed. 20m southwest of Target 1 a large flat patch of shell hash lead to a small outcrop of carbonate approximately 1.5m high; large amounts of small mussels in-between larger mussels were observed over the carbonate outcrop. Alvin carried out a photo transect (time: 13:33) before taking a sample of pink bubblegum coral (time: 13:38). During the transect octopus, chimaeras, sea urchins, rays, anemones (mostly flytrap anemones) and thresher sharks were observed. 4K footage of the mussel bed was taken (time: 14:20) before taking a slurp (time: 14:22) and mussel sample (14:31). Additional 4K footage was taken of a sponge on the coral (time: 14:57) as well as the pink and white bubblegum coral (time: 15:26). The white bubblegum coral was sampled but required greater force to sample than the pink species/morphotype (time: 15:27). Push cores proved difficult due to the shallow depth of sediment; Cores 1, 4 and 5 were lost. Two pairs of push cores were taken in bacterial mats (time: 15:36, 16:20) and two pairs near mussel beds (time: 15:54, 17:03). Alvin observed a long line of carbonate outcrops stretching towards target 4 and 5; corals were abundant on the carbonate throughout the transit. Small patches of mussels were observed with bacterial mats over some of the mussels. Sea urchins and crabs were observed but no Onuphids appeared to be at this site. At target 5 a large mussel bed on top of a carbonate mound was located (time: 17:41). There were more uniformly large mussels across the mound with only a few patches of high density, small mussels. An active bubble plum was observed with a small amount of methane hydrate (time: 17:53).

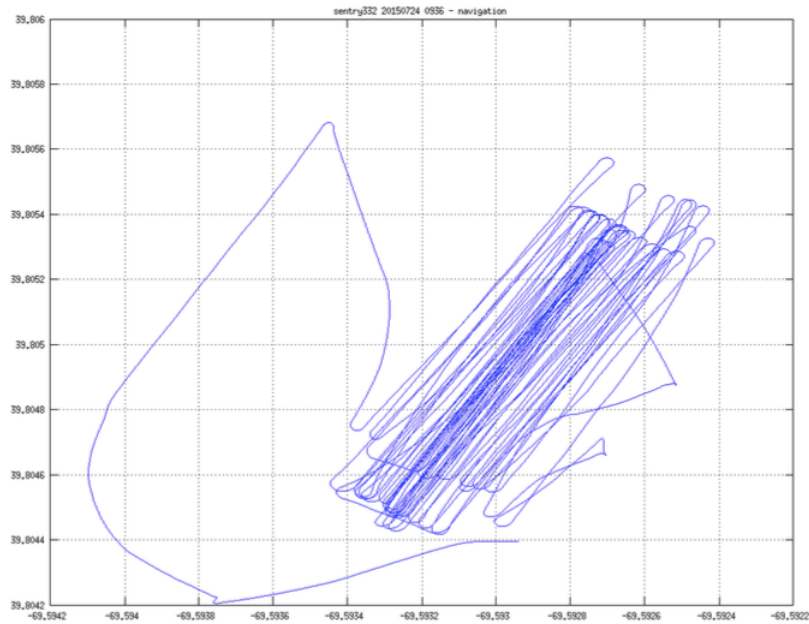
1530 Alvin 4810 Veatch Canyon recovery



Alvin 4810 Veatch Canyon

1600 Multibeam and Seismic Survey

1800 Sentry/SyPRID Veatch Canyon above mussels, 5 m and to 1.5 m



Sentry 332 Veatch Mussels 5 and 1.5 m

Friday 24 July

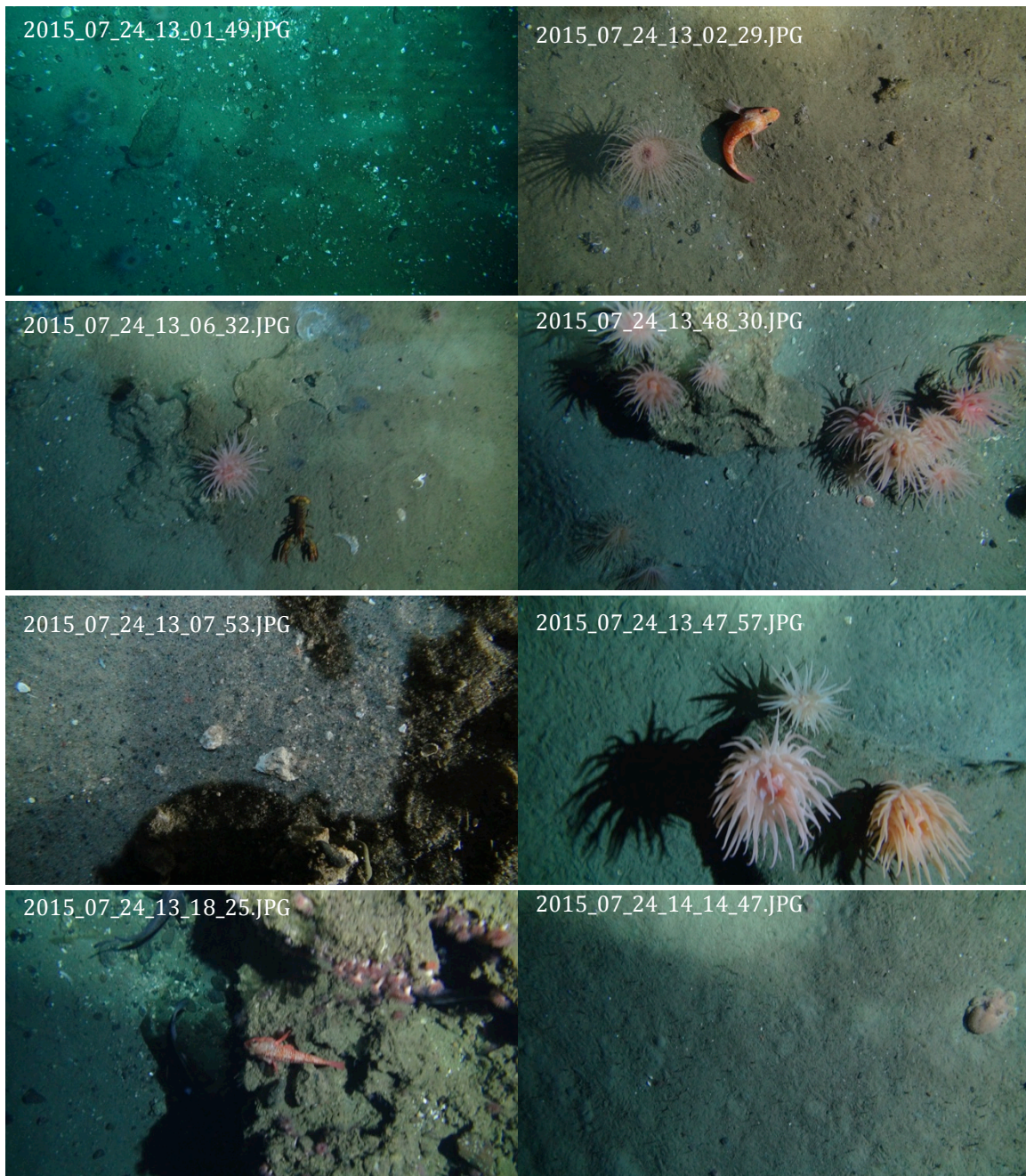
0530 Sentry/SyPRID secure on deck

0530 Transit to Shallop Canyon

0800 ALVIN 4811 Shallop Canyon East (316m).

Alvin visited 3 of 5 targets, observing active bubbling, carbonate and shell hash (very small fragments) at target 3 (time: 12:51). Large anemones, crabs, fish, sponges and lobsters were observed when transiting between targets. At target 3, 4K-footage was taken of a lobster (time: 12:55) and carbonate with sponges (13:11); the carbonate was sampled (time: 13:11). Alvin moved to target 2 observing active bubbling but no mussels. There were patches of bacterial mat at target 2; two push cores were taken (time: 13:34) but one failed and the other was very shallow. Target 1 was characterized by soft sediment with a few rocky outcrops and anemones; no carbonate was observed. Another two push cores were taken at target 1, sampling sediment with filaments on the surface (time: 14:03).

1100 ALVIN 4811 on Deck



Alvin 4811 Shallop Canyon East

1300 ALVIN 4812 Shallop Canyon West (390m).

Once at target 1, Alvin sampled carbonate with a sponge attached (time: 18:00). After sampling the manipulator arm broke, so no other sampling was possible at this site. Alvin visited the remaining targets searching for mussels. At target 3 shell hash was present (time: 18:16). At target 4 bacterial mats, bubbles, shell hash and carbonate were observed (time: 18:36). Target 6 observations include patchy bacterial mats (approx. 0.25m wide), high-density shell hash and active bubbling (time: 19:23). The

fauna observed included anemones, lobsters, fish and octopus. At target 7 approximately 10 mussels were located (time: 20:18) in addition to active bubbling and bacterial mats. A slurp sample was taken in an attempt to collect mussels; some small mussels were collected (time: 20:22).

1700 Alvin 4812 Recovered

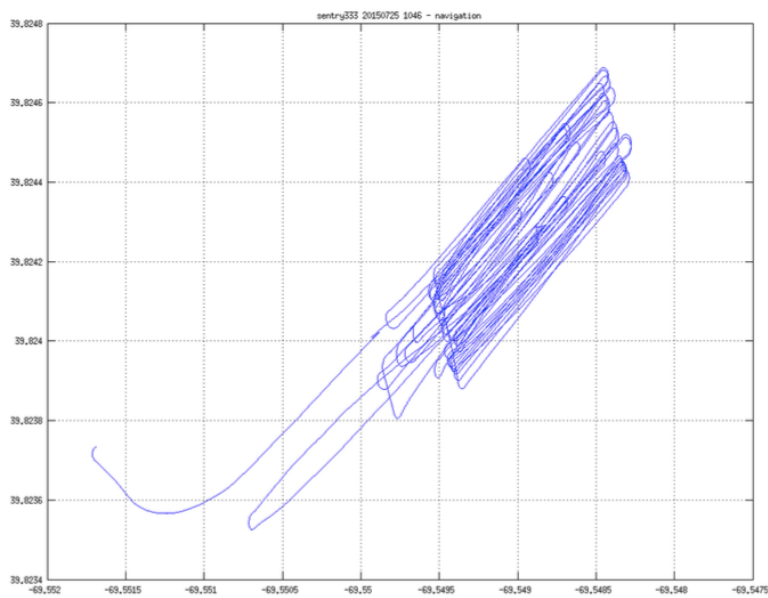
NO GOOD DOWN-LOOKING IMAGES from ALVIN 4812.

Transit to Veatch Canyon Reference Area, multibeam

2000 Sentry/SyPRID 333 Veatch Canyon Reference Area

0600 Sentry/SyPRID 333 recovery

We recovered Sentry333 this morning about 0630. It was another reference site dive and was once again a two level dive splitting up the sides of SyPRID. The 5m section went well, but during the 1.5m flight, we had spurious readings from the 300DVL which our filters didn't catch and which drove us into the ground. We know in principle how to modify the altitude switchyard, but it is unclear if we will attempt the fix this close to the end of the cruise. We were able to finish the dive at 2.5m and likely the samples should be fine.

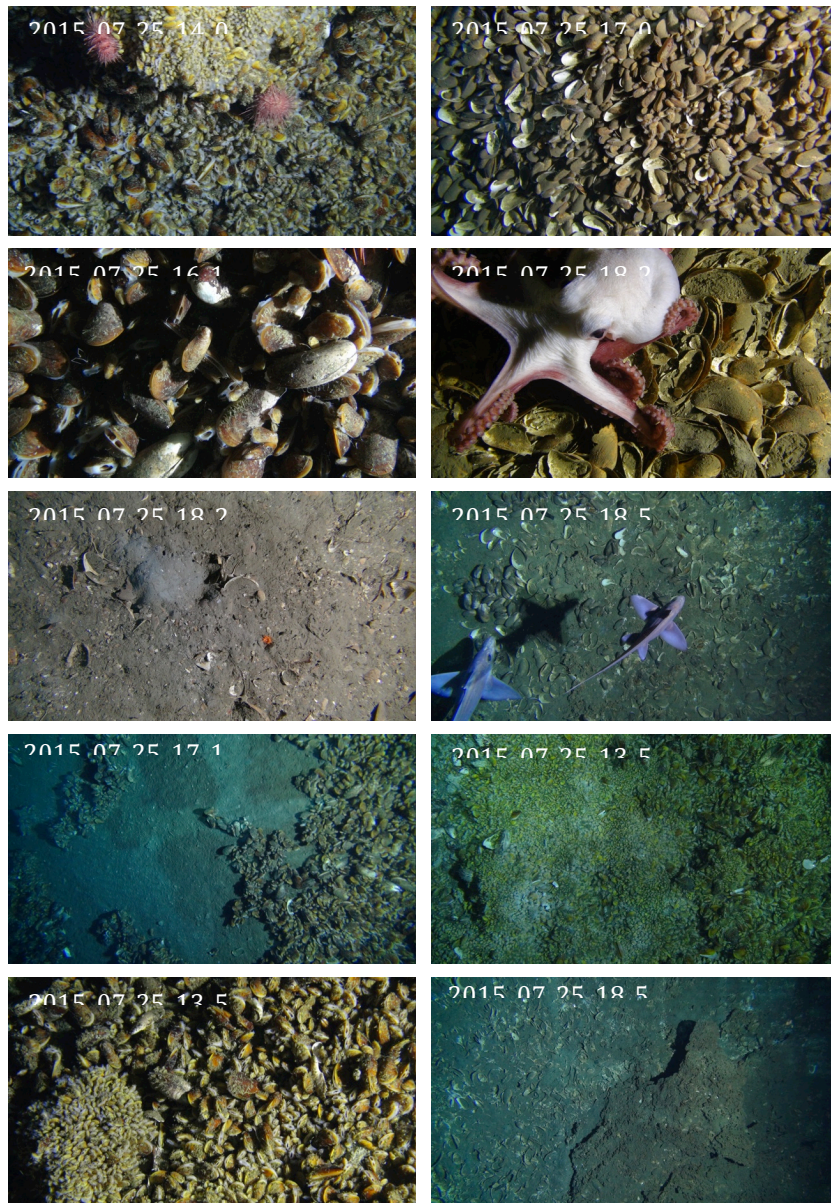


0630 Transit to Veatch Canyon

0800 Alvin 4813 Veatch Canyon

1700 Alvin 4813 Recovery

Veatch Canyon (1420m). Alvin observed extensive mussel beds throughout the dive (10-100's of meters of mussel bed). Two slurp samples were taken (time: 14:38, 16:20) before mussels were collected (time: 14:41, 16:14). 6 push cores were completed, two pairs near mussel beds and one pair in bacterial mats (time: 15:32, 18:39, 19:08). Carbonate rock was also sampled (time: 17:58). Three areas of active bubbling with methane hydrate were located. Coral communities (cup and branching coral species) were also observed on a 2-3m carbonate pillar. 3 photo transects were completed (time: 16:50, 17:04, 18:53). 4K video footage of bubbling, the carbonate pillar, pink bubblegum coral and methane hydrate was obtained.



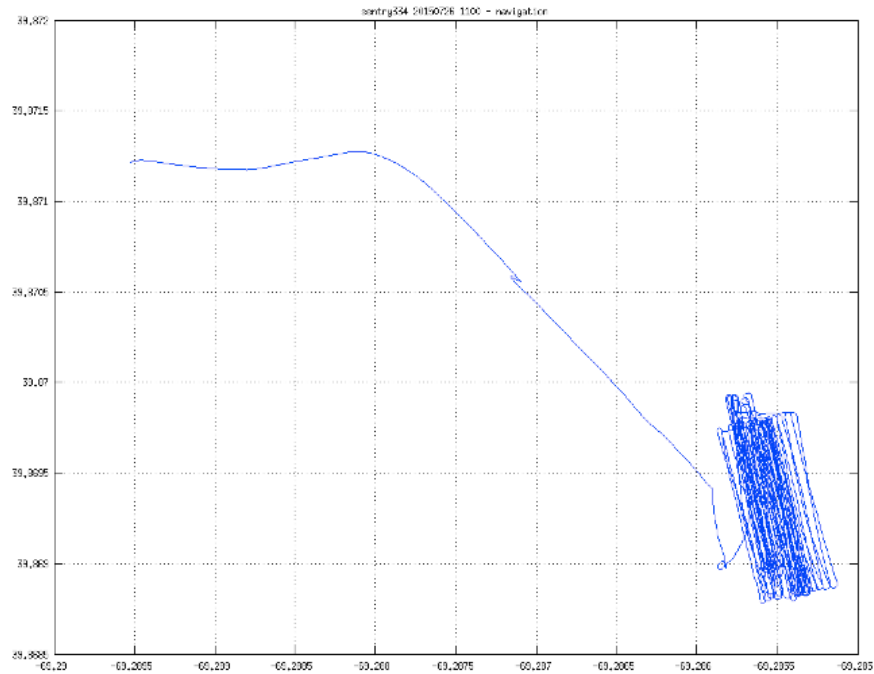
Alvin 4813 Veatch Canyon

1830 Sentry/SyPRID 334 New England Seep 2

xxxx CTD, New England Seep 2

Sunday 26 July 2015

0600 Sentry/SyPRID 334 New England Seep 2 recovery



Sentry/SyPRID 334 New England Seep 2

0800 Alvin 4814 Shallop West 2

1600 Alvin Recovery Shallop West (327m).

Alvin relocated the plume and mussel site visited during A4812, observing small fragments of shell hash in-between fractured carbonate platform. Anemones and cerianthids dominated the area; cancer crabs, squat lobsters, various fish species and lobster were also observed. At the end of the carbonate trail, a 2m high non-carbonate boulder was located with active bubbling around it. ~6-8 mussels were observed on the side of the rock and a sample of 3 were collected (time: 13:03). A photo transect was completed (time: 13:38) and a sample of carbonate was taken (time: 14:01). 4K-video footage was taken of carbonate pavements, anemones and lobsters. Alvin transited to plume 2 observing similar stretches of carbonate pavement, some showed active bubbling (e.g. time 14:41) but no mussels were observed. Whilst transiting to plume 3,

similar carbonate platforms were observed, dominated by anemones, cancer crabs and cerianthids; bubbling was observed and some large shells were seen in the shell hash. Along transit to Plume 3, five large Onuphid worms (*Hyalinoecia artifex*) were sampled (time: 15:50). At plume 3, we observed fractured carbonate in a ridgeline, sporadic bubbling was observed across the carbonate and shell hash contained many large shells, some complete. A small sample of live mussels was collected (time: 16:59), but very few live mussels were observed. Travelling down slope in a southeast direction from Plume 3, Alvin reached the edge of the carbonate pavement. Beyond this the slope was densely covered in shell hash and then gave way to soft sediment. Bubbling, potential methane hydrate and a small clump of mussels (time: 17:20) were observed and filmed with the 4-K video. Alvin sampled the mussels before surveying the area for bigger patches of mussels. No more mussels were observed.



Shallop West; Amphipods and krill (*Meganyctiphanes norvegica*?) from slurp

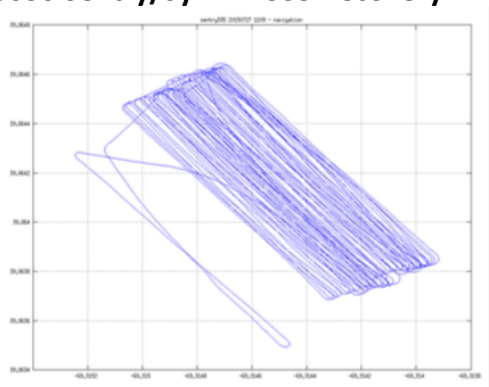


Alvin 4814 Shallop Canyon West specimens

1700 Sentry/SyPRID 335 New England Seep 2 Reference

Monday 27 July 2015

0630 Sentry/SyPRID 335 Recovery



0800 Alvin 4815 New England Seep