Appendix 2: CTD Casts

Note: Most casts also have a deck test file used for calibrating optical sensors.

Profile #	Date & Time	Latitude DD°MM.MM'	Longitude DD°MM.MM'	Maximum Depth (m)	Time at Max Depth	# of Bottles
CTD001	May 31 2013 11:39:56	24 32.67 N	084 11.60 W	2200	13:00	24
CTD002	Jun 02 2013 10:48:13	18 22.68 N	081 47.98 W	2388	11:39	24
CTD003	Jun 02 2013 16:00:20	18 22.66 N	081 49.96 W	2100	16:49	24
CTD004	Jun 02 2013 19:29:50	18 22.68 N	081 49.95 W	250	19:38	0
CTD005	Jun 03 13 21:08:50	18 32.84 N	081 43.10 W	4839	23:49	24
CTD006	Jun 04 2013 04:40:11	18 32.85 N	081 43.21 W	4849	06:36	0
CTD007	Jun 05 2013 08:15:48	17 51.62 N	081 50.09 W	4255	10:04	24
CTD008	Jun 05 2013 13:18:28	17 53.76 N	081 48.02 W	4051	14:49	24
CTD009	Jun 05 2013 18:11:05	17 51.63 N	081 48.07 W	4539	19:44	24
CTD010	Jun 05 2013 23:12:09	17 52.78 N	081 49.68 W	4055	00:51	24
CTD011	Jun 06 2013 07:58:59	17 56.58 N	081 49.60 W	4163	09:52	24
CTD012	Jun 06 2013 19:50:20	17 50.71 N	081 50.44 W	3964	21:15	24
CTD013	Jun 06 2013 23:49:37	17 49.65 N	081 51.07 W	4172	01:41	24

CTD014	Jun 07 2013 07:56:24	17 49.98 N	081 51.19 W	3675	09:28	24
CTD015	Jun 07 2013 12:07:59	17 50.92 N	081 51.05 W	3476	15:17	24
CTD016	Jun 07 2013 17:48:49	17 51.59 N	081 50.51 W	3985	19:23	24
CTD017	Jun 08 2013 16:34:11	17 49.42 N	081 52.13 W	4454	18:18	24
CTD018	Jun 08 2013 21:30:45	17 49.35 N	081 51.60 W	4525	23:10	24
Profile #	**Date & Time**	**Latitude DD°MM.MM'**	**Longitude DD°MM.MM'**	**Maximum Depth (m)**	**Time at Max Depth**	**# of Bottles**
CTD019	Jun 09 2013 02:10:03	17 49.99 N	081 50.66 W	4038	06:41	24
CTD020	Jun 09 2013 11:35:03	17 48.51 N	081 50.74 W	5252	14:01	24
CTD021	Jun 09 2013 17:59:45	17 49.50 N	081 51.05 W	4150	19:36	24
CTD022	Jun 10 2013 22:38:49	18 22.69 N	081 48.10 W	2014	23:19	24
CTD023	Jun 11 2013 08:00:33	18 32.81 N	081 43.15 W	4958	10:23	24
CTD024	Jun 11 2013 14:28:01	18 32.79 N	081 43.18 W	4926	17:16	24
CTD025	Jun 12 2013 01:19:55	18 22.51 N	081 48.40 W	2300	02:40	24
CTD026	Jun 12 2013 23:31:56	18 22.28 N	081 49.80 W	2182	00:32	24
CTD027	Jun 14 2013 00:38:00	18 22.65 N	081 48.10 W	2326	01:50	24

CTD028	Jun 14 2013 23:43:30	18 22.63 N	081 48.10 W	2322	01:45	24
CTD029	Jun 21 2013 11:49:31	18 22.69 N	081 47.95 W	2139	12:38	24
CTD030	Jun 23 2013 16:25:10	18 32.80 N	081 43.13 W	4945	18:31	0
CTD031	Jun 23 2013 21:32:30	18 32.87 N	081 43.27 W	4967	23:20	24
CTD032	Jun 25 2013 00:25:12	18 32.79 N	081 43.20 W	2304	01:14	24
CTD033	Jun 25 2013 22:52:59	18 32.79 N	081 43.17 W	4968	00:42	24
CTD034	Jun 26 2013 22:10:44	18 22.50 N	081 47.92 W	3213	23:14	24
CTD035	Jun 28 2013 23:27:16	18 32.82 N	081 43.18 W	4975	01:33	24
CTD036	Jun 29 2013 22:19:01	18 32.88 N	081 43.17 W	4992	00:22	24

Nereus Operations Report for the 2013 Mid-Cayman Rise Cruise

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

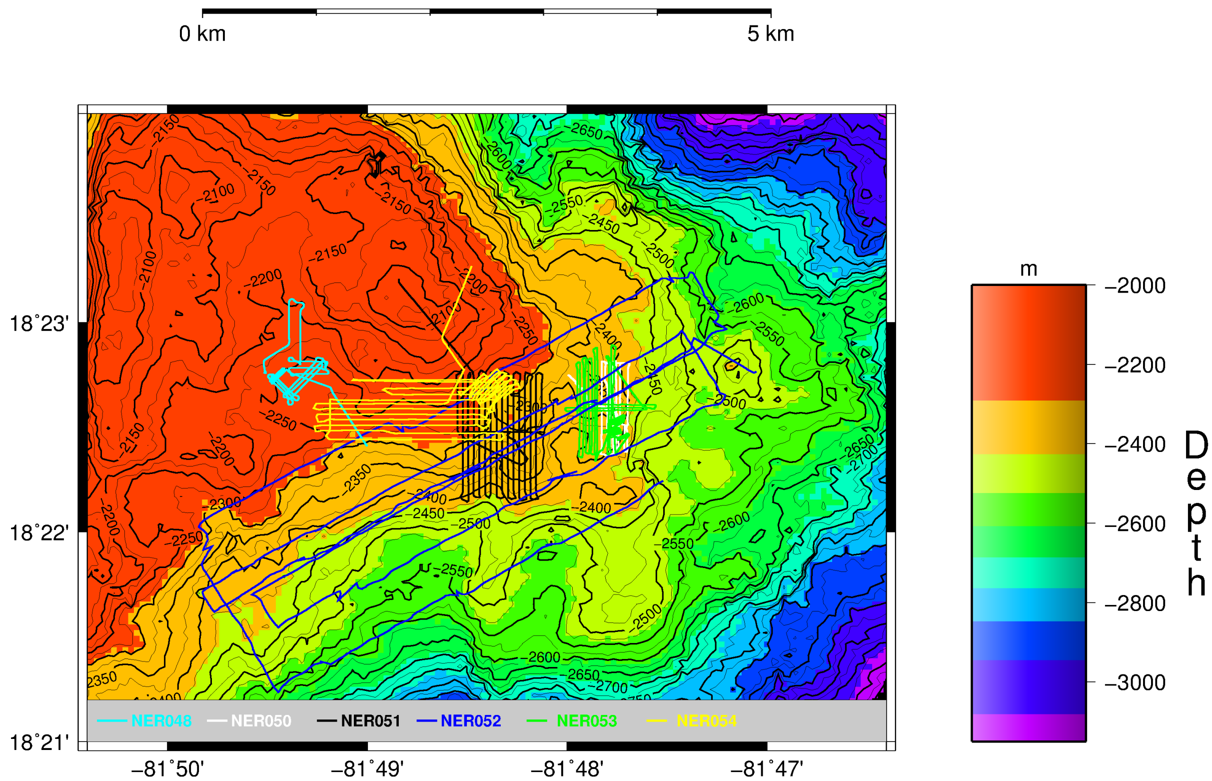


Figure 1: Tracklines of the AUV dives during Leg 1. Nereus 047 and 049 were short dives and are not shown.

1 Summary

This document summarizes AUV operations with *Nereus* during the first leg of the 2013 Mid-Cayman Rise cruise. Included in this report is the vehicle configuration; basic vehicle and sensor performance; and post-dive reports (with summary statistics and narratives). This report does not attempt to describe the scientific results or conclusions. A detailed description of the data files resulting from this cruise is provided in a separate document. Data provided to science is included in the data summary document for this cruise.

2 Navigation

All dives were navigated using realtime Doppler velocity log (DVL) velocity inertial measurement unit (IMU) attitude measurements. External aiding during descent was done with ultra-short-baseline (USBL) throughout the cruise. Dive specific notes on navigation are included in the dive reports. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

2.1 Coordinate origins

The vehicle's control system uses simple mercator coordinates. This system uses an origin, defined in terms of latitude and longitude with the world geode standard 1984 (WGS84) datum, and a fixed scaling between meters displacement from the origin. We use the identical routines that have been used by the National Deep Submergence Facility (NDSF) assets Alvin and Jason for decades. These simple coordinates have several advantages for realtime control of a vehicle. Unlike universal transverse (UTM) grid coordinates, the x and y axes intersect at right angles and align with true east and north respectively at the origin. These coordinates distort quickly as one moves away from the origin, but we solve that problem by putting the origin close to the operating area. We almost always report our results in latitude/longitude, so most users need not be aware of these details.

Individual dive origins are given in each dive report attached at the end of this cruise report.

Nereus 047 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

Nereus047 was an engineering dive on Mount Dent. The goal was to verify Nereus's ability to collect bathymetric, magnetic, photo, and water column data. Nereus descended successfully but was excessively negatively buoyant—barely able to hold depth but unable to ascend. This diagnosis was performed acoustically after which the dive was aborted acoustically. Nereus was recovered amidships using a combination of ship motion and joysticking. The remainder of recovery was smooth.

Weather: Unremarkable.

Reason for end of dive: Acoustic abort.

Vehicle Configuration

The science sensing suite for this dive was:

Table 1: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 conductivity-temperature-depth (CTD)
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

Deployment went smoothly. Nereus descended to the seafloor completing its descent as expected.

It was apparent early on that something was amiss. The vehicle appeared unable to ascend to survey height, instead holding depth. The fact that the vehicle appeared to be holding depth suggested a mission or software problem so we spent some time trying to diagnose the issue over the acoustic channels with the aim of configuring the vehicle or altering the mission and associated parameters to fix the problem. Interrogation of the controller, and actuators ultimately revealed that the vehicle was thrusting up at maximum current (15 A) but unable to ascend. We concluded the vehicle must be negatively bouyant, but, remarkably, so precisely negative as to match the maximum thruster of the forward vertical when in hover configuration. A few hours were spent drifting over the seafloor while making this diagnosis during which we carefully monitored the altitude. Though we devised a definitive test to confirm the negative buoyancy hypothesis, we did not carry it out because the vehicle's altitude never exceeded more than a few 10s of meters and we did not feel confident that a crash could be avoided if in fact the negative buoyancy hypothesis was true.

Recovery was smooth, performed amidships with a combination of vessel motion and joysticking the vehicle to approach the ROV bay at a heading perpendicular to the vessel.

Issues and Proposed Solutions

1. This dive ended on account of excessive negative buoyancy. Inspection of the vehicle data after recovery provided ample ballasting information. By comparing ascent and descent rates with the forward vertical thrusting at various current commands (Fig. 2) we concluded that the vehicle was indeed negative, by approximately 60 lb (based on flume data collected previously for this propeller). Ballasting for the following dive was corrected conservatively by removing 30 lb of lead.

Survey start: 2013/06/03 11:59:35
Survey end: 2013/06/03 16:20:53
Ascent begins: 2013/06/03 16:34:43
On the surface: 2013/06/03 18:08:43
On deck: 2013/06/03 18:40:30
descent rate: 29.2 m/min
ascent rate: 23.7 m/min
survey time: 4.4 hours
deck-to-deck time 7.9 hours
Mean survey depth: 2204m
Mean survey height: 28m
distance travelled: 5.90km
average speed; 0.10m/s
average speed during photo runs: 0.33 m/s over 3.12 km
average speed during multibeam runs: 0.10 m/s over 1.57 km
total vertical during survey: 260m
Battery percent at launch: 93.5

Battery percent at descent end: 91.5
Battery percent at survey end: 67.0
Battery percent on deck: 58.2
Note: Distance traveled numbers are not accurate.

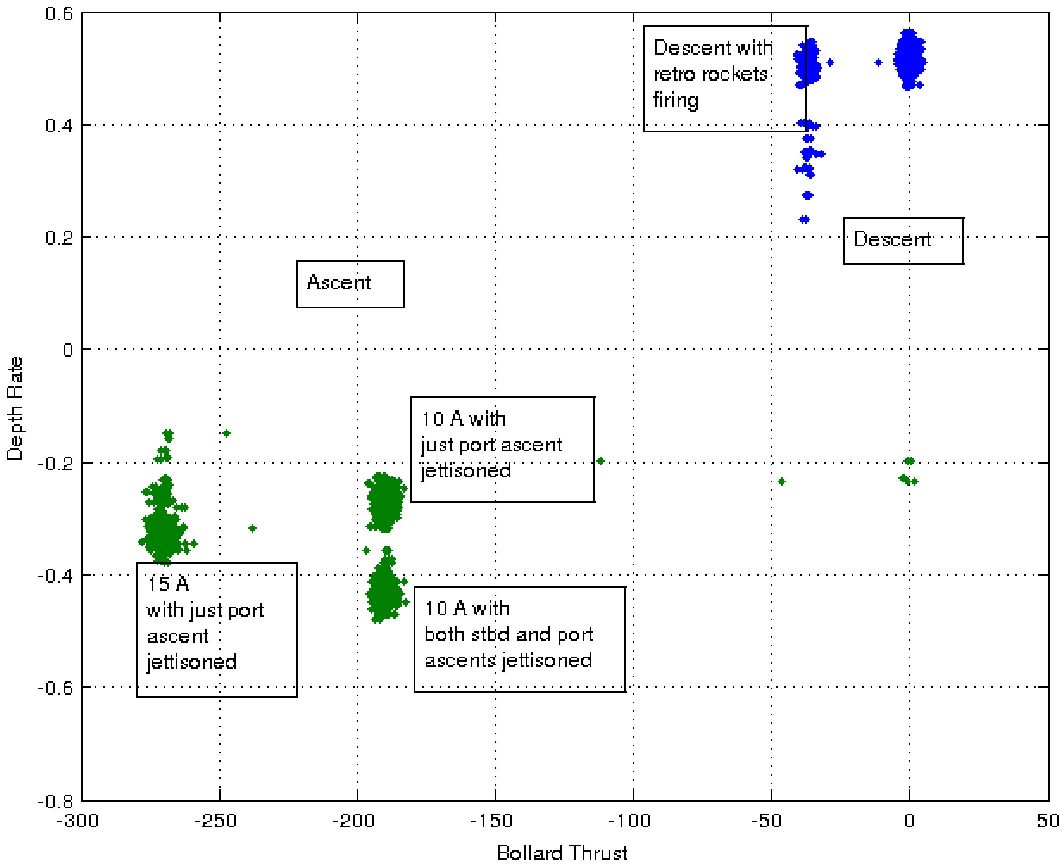


Figure 2: Ballasting diagnosis for nereus047.

Nereus 048 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

This dive was a repeated attempt at the mission planned for nereus047. The mission was designed to demonstrate the vehicle's ability to conduct bathymetric, magnetic, photo, and water-column survey. The mission went smoothly until the last trackline. The vehicle maintained depth and course but acoustic interrogation of the vehicle revealed communications problems between the processes on board. We aborted the vehicle acoustically. Upon surfacing the vehicle was unresponsive to joystick commands over the RF link. Recovery was performed by small boat. The hard disk on the vehicle's main CPU was found to have failed during the latter part of the dive but the vast majority of data remained intact on the disk. While the hard drive failure required significant work on the turn-around, the dive did provide a successful test of a majority of Nereus AUV mode systems.

Weather: Unremarkable.

Reason for end of dive: Acoustic abort.

Vehicle Configuration

The science sensing suite for this dive was:

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Table 2: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

Narrative

The dive was designed to test the vehicles ability to fly while holding constant depth, bottom follow over relatively benign terrain at a safe height (100 m), bathymetry survey height (40 m), magnetics survey height (25 m), and photo survey height (5 m), and finally to “yoyo” in the water column. The photo survey was conducted in hover configuration, all other elements of the dive were conducted in level flight allocation (with failsafe switch into hover engaged as necessary).

Vehicle control while holding constant depth or bottom following was acceptable; with the caveat that the terrain selected was deliberately benign. Performance during the yoyo was compromised by occasional bad altitude measurements that held the vehicle at the top of the yoyo envelope.

During the camera survey various gains were commanded; however, only unlit images were collected. One of the strobe drivers was turned off accidentally prior to launch which ultimately resulted in destruction of the triggering electronics on the dive itself.

During the yoyo, on the last trackline of the dive, the hard disk failed. The vehicle stopped responding to commands and continued to fly its last line until acoustically aborted. Forensics on deck revealed that in addition to the hard disk failure the network on board the vehicle was compromised by high-rate error messages. The sonardyne channel, being directly connected by serial port to the main CPU, was critical to issuing the abort command because it is the only method that does not require network functionality (excepting the independent emergency transponder).

The hard-disk failure and subsequent network overload resulted in dead vehicle recovery. Fortunately a small-boat recovery was already planned so this had little impact on the recovery procedure.

Issues and Proposed Solutions

1. The hard disk failure suffered during this dive precipitated extensive forensics that were compromised by a lack of system logs post-failure. Ultimately we decided to dive again (nereus049) on the same hard drive because (1) the stack booted without error after a power cycle; (2) the drive reported no SMART errors; (3) the control processes appeared as though they continued to function but were unable to communicate because of the network failure. We implemented a fix to the error message flood (below). We also configured critical logs to be sent to the camera CPU for redundant logging there. We also configured the console Moxa on the main CPU to also be logged on the camera stack to aid diagnosis in the event of another hard drive failure. Finally we added an acoustic message containing the number of failed logging events to alert operators topside in the event of another hard disk failure.

2. The error message flood was caused by a loopback in the logging thread of the main control process

(rov). A failed fopen() call resulted in an error message which was configured to be logged, thus triggering another error message ad infinitum and with no restriction on the rate of issuance. The solution implemented was to configure the main control process to not log error messages, and only to send them via UDP for logging externally.

3. The ultimate cause of the strobe failure was traced to the decktest. The mission controller enters its normal ascent process at the conclusion of the decktest. This is useful to confirm that it drops weights correctly. However, it also switches various devices on and off during ascent. Operators killed the mission controller after it had turned off one channel of the strobe driver without realizing this had happened. The mission controller was altered to include a 5 minute wait after dropping weights and before continuing with ascent during which it prompts operators to kill the process.

4. The engineering nature of this dive required significant hand-editting of the mission tracks file, in particular to add a ballast test and to configure the vehicle to execute its yoyo behavior. Partial support was added to the mission planning to support these behaviors but remains incompletely implemented.

5. The susceptibility of the yoyo behavior to occasional altitude measurements should be corrected in the mission controller which manages the yoyo behavior. The standard approach to altitude outliers (a "hit-count") should be implemented therein.

6. The mission plan contained one blunder. The vehicle was commanded to transition directly from camera survey to yoyo behavior. Normally the bottom follower sets the desired forward speed, but this behavior is disabled for the yoyo behavior. The vehicle was placed into a dangerous situation by being commanded to increase speed to 1.0 m/s while still at camera survey height (5 m).

Dive Statistics

Survey start: 2013/06/04 13:47:46
Survey end: 2013/06/04 17:49:12
Ascent begins: 2013/06/04 17:51:13
On the surface: 2013/06/04 17:53:14
On deck: 2013/06/04 17:55:32
descent rate: 26.9 m/min
ascent rate: 977.4 m/min
survey time: 4.0 hours
deck-to-deck time 5.5 hours
Mean survey depth: 2118m
Mean survey height: 72m
distance travelled: 6.46km
average speed; 0.67m/s
average speed during photo runs: 0.77 m/s over 2.73 km
average speed during multibeam runs: 0.64 m/s over 7.12 km
total vertical during survey: 1099m
Battery percent at launch: 98.0
Battery percent at descent end: 95.9
Battery percent at survey end: 71.8
Battery percent on deck: 71.1

Note: Distance traveled numbers are not accurate.

Nereus 049 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

A magnetics survey of the Von Damm Hydrothermal Vent field with 25m spaced tracklines at 25m altitude. Propeller became disengaged early in the dive and required we abort the dive.

Weather: Unremarkable. Had no effect on operations.

Reason for end of dive: Mission was acoustically aborted after we determined that the vertical propeller had been disengaged. During the ascent, the hard drive failed which, if the propeller had remained attached, would have required an abort.

Vehicle Configuration

The science sensing suite for this dive was:

Table 3: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

The launch went smoothly. During the first few hundred meters of descent, we had poor USBL tracking and SMS telemetry. SMS messages were being received; however, they were corrupted (see the Nereus049 dive log for examples). At around 600m, both USBL tracking and telemetry improved and remained good throughout the remainder of the dive.

Throughout the descent, we observed a continous stream of altitude fliers rather than the sentinel -3 value normally reported. Querying the altitude switchyard queue showed that we were using the min DVL beam range. There was concern that once *Nereus* passed the descent enable depth, that the continuous stream of altitude fliers would prematurely conclude that the seafloor was less than 80m away and prematurely terminate the descent process. Fortunately, the requirement that the altitudes be continuously decreasing prevented this from happening though the randomness of the altitude fliers could have allowed this to happen.

Upon achieving DVL bottom-lock, the internal nav estimate was updated acoustically. *Nereus* was observed to be *not* driving down. A WAJ 0 command was issued to disable the mission controller and prevent *Nereus* from driving while we acoustically interogated the vehicle to get more information. Queries of the control (011) and DVZ (041) queues revealed that *Nereus* was being commanded to drive down and was getting valid DVL measurements. The vertical thruster queue (015) showed that the thruster was spinning at 700-925 which was a comparable magnitude to the values seen on Nereus047 when Nereus was thrusting up with full power. However the observed current was 1-3A — significantly lower than the 15A maximum. This indicates that the motor was spinning but not under load, most likely because the propeller had become disengaged. Power was cycled on the elmo to see if that would correct the problem. That failed to correct the problem and the decision was made to acoustically abort the dive.

Zero-hold altitude fliers persisted during the ascent. Recovery was delayed because the small boat davit was not working.

While awaiting recovery we checked vehicle telemetry and computer status via RF comms. Telemetry was reliable but we couldn't login to the main PC 104 stack. Inspection of the main stack serial console on the imaging stack confirmed that the main stack hard drive had failed again. Neutering of the SDE UDP broadcasts in ROV did prevent the network failures observed on Nereus048. Once on deck, we observed serial traffic on the battery serial port which indicated that ROV was still running. Power to the stack was shut off by jamming the power switch command through to ROV. The stack rebooted fine and with no errors; however, hard drive failures on two consecutive dives required us to replace the drive prior to Nereus 050.

Issues and Proposed Solutions

1. The propeller on the vertical thruster detached at some point during the descent or early in the dive.
2. On the ascent, the hard drive failed. We subsequently replaced the hard drive. *have a separate engineering discussion?*
3. USBL tracking was poor for the first few hundred meters of the dive. More importantly, corrupted USBL messages were received during this time. It is unclear what caused these messages or why the Sonardyne software allowed them to be passed on. This was the only time on the AUV leg that corrupted SMS messages were observed.

4. Altitude switchyard

Dive Statistics

Survey start: 2013/06/08 09:42:22
Survey end: 2013/06/08 10:39:45
Ascent begins: 2013/06/08 10:43:53
On the surface: 2013/06/08 11:48:52
On deck: 2013/06/08 11:50:05
descent rate: 22.7 m/min
ascent rate: 33.9 m/min
survey time: 1.0 hours
deck-to-deck time 3.8 hours
Mean survey depth: 2214m
Mean survey height: 109m
distance travelled: 4.54km
average speed; 0.16m/s
average speed during photo runs: 0.46 m/s over 0.36 km
average speed during multibeam runs: 0.16 m/s over 0.54 km
total vertical during survey: 202m
Battery percent at launch: 96.8
Battery percent at descent end: 92.4
Battery percent at survey end: 88.3
Battery percent on deck: 86.0
Note: Distance traveled numbers are not accurate.

Nereus 050 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

A second attempt at a magnetics survey of the Von Damm Hydrothermal Vent field with 25m spaced tracklines at 25m altitude. Despite early difficulties with the altitude switchyard, we were able to complete the dive, albeit at a higher altitude (50m) over the Von Damm mound. Magnetic data obtained during this dive was sent ashore for analysis by Maurice Tivey and informed our plan for Nereus 053.

Weather: Fine. Did not affect operations.

Reason for end of dive: Mission timeout imposed by ship to ensure a daylight recovery. Approximately 85% of the pre-programmed tracklines were completed.

Vehicle Configuration

The science sensing suite for this dive was:

Table 4: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

Launch went fine and SMS telemetry was available starting at 140m. During descent, we noted sentinel altitude switchyard values of -2. The descent weight dropped at 80m, the nav correction was applied, and *Nereus* started driving at 0.5 m/s. *Nereus* drifted significantly during the descent and had to travel a few hundred meters to the survey start. During this time, bottom-following worked fine.

As *Nereus* approached the Von Damm Mound, it slowed and struggled to climb the mound. In an effort to help the vehicle move along, we increased the altitude to 60m. During this time, we observed numerous altitude values of -2 which command the vehicle to drive down. *Nereus* was commanded to 25m altitude in an effort to put it back inside the altitude envelope. By this point, the vehicle had tracked out on the northern half of the first trackline so the vehicle drove south. During the downslope drive, a combination of low altitudes and -2 values occurred and, soon after, *Nereus* crashed into the seafloor.

A series of commands were sent to put the vehicle in safe command (WAJ 0; CFG 28; WGA 2 2200). After stabilizing *Nereus* we set the commanded altitude to 50m and continued the survey over the central mound. -2 values continued to be seen but the vehicle was sufficiently high that it would be re-obtain a good altitude value well before *Nereus* got near the seafloor. *Nereus* would also occasionally go back into irons. Decreasing the depth floor proved to be a simple and efficient way to "bump" the vehicle out of irons and allow it to continue. The survey continued like this for the remainder of the dive. Once *Nereus* was away from the mound, the commanded altitude was decreased to 25m to improve the quality of the magnetics survey. During the 25m survey, we observed overshooting of the tracklines (this was observed in later dives and is discussed in the Nereus 053 report).

The mission ended when the mission controller timer expired. Ascent and recovery proceeded smoothly. The Benthos deck box was used to ping the emergency bottle and send an acoustic abort. Upon recovery, we verified that the wires had burned.

Issues and Proposed Solutions

1. Altitude Switchyard — The -2 values seen throughout the dive were the result of an initialization error in the altitude switchyard. Specifically, the MIN and MAX ranges for the 881 had both been set to -1.0 in essentially forcing Case D into reporting -2 (drive down) when the DVL reports 0. Additionally broke case G by setting the DVL MIN range too low (0.5m) and the timeout too long (15s), which for low altitudes, was too low and too long to allow the vehicle to recover. Numerous changes were made to correct this bug; see the rov hg repository (changeset: 1f12a49a4617) for more information in both the code and in the log. Diagnostic plots are also included in the proc/rov directory.

Dive Statistics

Survey start: 2013/06/10 09:51:49
Survey end: 2013/06/10 19:09:40
Ascent begins: 2013/06/10 19:17:57
On the surface: 2013/06/10 20:38:49

On deck: 2013/06/10 21:24:26
descent rate: 21.2 m/min
ascent rate: 29.1 m/min
survey time: 9.3 hours
deck-to-deck time 13.3 hours
Mean survey depth: 2304m
Mean survey height: 40m
distance travelled: 6.63km
average speed; 0.21m/s
average speed during photo runs: 0.21 m/s over 2.60 km
average speed during multibeam runs: 0.22 m/s over 6.52 km
total vertical during survey: 2596m
Battery percent at launch: 96.4
Battery percent at descent end: 93.5
Battery percent at survey end: 62.0
Battery percent on deck: 57.7
Note: Distance traveled numbers are not accurate.

Plots

Nereus 051 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

The dive was an attempt to follow up on Eh anomalies observed by the Autosub AUV in 2010 in an area to the west of the Von Damm hydrothermal field. Strong anomalies were observed during the last hour of the survey. Modifications were made acoustically to the mission plan and continued to encounter anomalies until the mission timer ended the dive. These anomalies, combined the CTD casts, informed our dive plan for Nereus054.

Weather: Unremarkable.

Reason for end of dive: Mission timeout imposed by ship in order to ensure a daylight recovery.

Vehicle Configuration

The science sensing suite for this dive was:

Table 5: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

The primary objective of this dive was to find the source of the Eh anomaly observed by the Autosub AUV in 2010. Hydrographic data from the CTD program had turned up methane anomalies in the same region and suggested the presence of an additional hydrothermal plume not emanating from Von Damm. A secondary objective was to produce a bathymetric map of the region.

The vehicle flew at 40 m altitude with tracklines spaced at 50 m. The survey was planned in three blocks, a central block over the target, followed by an eastern block and finally a western block. A final crossing leg over the autosub target was initially planned at 40 m altitude, but after no anomalies were observed with only 2 hours remaining on the mission timer, we opted to abandon the rest of the planned survey to the east and descend to camera height for the crossing leg to the west. These changes were successfully telemetered acoustically and photos successfully collected. The 40 m altitude survey recommenced on the western block with all tracklines telemetered acoustically. Eh anomalies were encountered (observed topside via the acoustic uplink) with one hour remaining on the mission timer. The anomalies, confirmed as unequivocal post-dive, continued to be encountered over terrain that had been surveyed at the same altitude earlier in the dive leading to speculation that a shift in tidal currents may have carried the anomalies into the survey area from the west.

The mission controller ended the dive on mission timeout, which was followed by a normal ascent and small boat recovery.

Issues and Proposed Solutions

1. Finer-grained control over mission modifications made acoustically might have enabled a more conclusive result with respect to the observed Eh anomalies. This effort is ongoing.

2. More sophisticated compression of Eh data might have made real-time interpretation of the observed Eh anomalies more informative. This effort is ongoing.

Chief Scientist Comments

Dive Statistics

Survey start: 2013/06/12 09:47:48
Survey end: 2013/06/12 20:49:05
Ascent begins: 2013/06/12 20:55:60
On the surface: 2013/06/12 22:18:56
On deck: 2013/06/12 22:48:54
descent rate: 21.3 m/min
ascent rate: 27.0 m/min
survey time: 11.0 hours
deck-to-deck time 14.6 hours
Mean survey depth: 2250m

Mean survey height: 43m
distance travelled: 19.63km
average speed; 0.55m/s
average speed during photo runs: 0.33 m/s over 2.66 km
average speed during multibeam runs: 0.55 m/s over 21.08 km
total vertical during survey: 3279m
Battery percent at launch: 96.3
Battery percent at descent end: 92.1
Battery percent at survey end: 23.1
Battery percent on deck: 17.1
Note: Distance traveled numbers are not accurate.

Plots

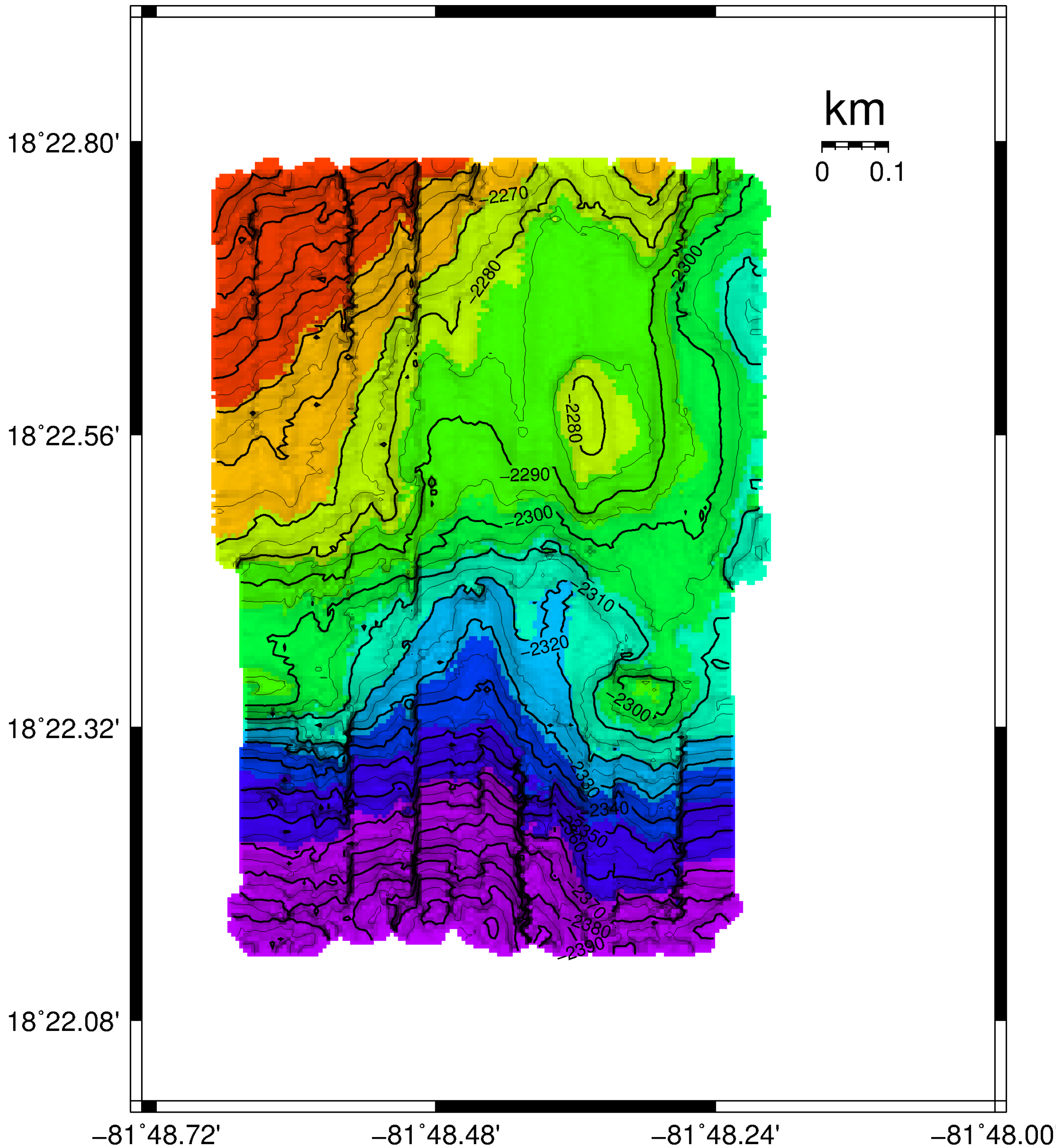


Figure 3: Bathymetry collected using an Imagenex 881 pencil beam mechanically scanned sonar.

Nereus 052 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

This dive conducted a high-altitude yoyo over a large (5 km x 2 km) area above and to the west of the Von Damm hydrothermal site. The objective was to elucidate the nature of the plumes above Von Damm—and specifically to answer the question of whether the plumes near Von Damm were representative of two distinct hydrothermal sources.

Weather: Unremarkable.

Reason for end of dive: Mission timeout to ensure recovery before sunset.

Vehicle Configuration

The science sensing suite for this dive was:

Table 6: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

Nereus successfully dropped its weights mid-water column at the commanded depth and began yoyoing. The yoyo behavior worked well, with altitude outliers rejected reliably and periods when the bottom impinged on the yoyo envelop handled correctly by ascending to the shallow limit of the envelope. The vehicle encountered plumes at various points during the dive. Nereus executed most of the dive above bottom-lock range which compromised dead-reckoning performance relative to near-bottom survey. Navigation fixes derived from the USBL system were successfully telemetered down to the vehicle on 15 minute intervals to correct its internal dead-reckoning (model-based when out of bottom-lock range).

Flight performance while ascending was excellent; flight performance while descending was compromised by actuator saturation and trim (+5 deg pitch at zero speed). Vehicle pitch during the descending legs of the yoyo was excessive and in opposition to the dive (+20 deg pitch). This resulted in a dramatic increase in drag which slowed forward progress, though the steady state depth rate attained was similar to ascent.

The on-board CTD data (temperature and derived products) are strongly correllated with the ascent vs. descent, with apparently much higher noise observed on the ascents. This appears to be due to electrical noise from the vehicle. During ascents the midplane and aft stabilizer were active and drawing variable current which appears to have bled into at least the temperature measurement of the CTD. During descents the midplane and aft stabilizers were saturated and drawing steady current. The thrusters were controlled open loop for the entire dive and drew constant current. Fig. 4 illustrates the effect. The implication is that cross-comparisons between the hydrographic data collected on ascending vs. descending legs may be compromised.

Upon mission timeout the vehicle initially ascended, then descended for a brief period before operators issued acoustic abort commands (Fig. 5). The vehicle was high in the water column and in no danger. The initial ascent was caused by the mission controller commanding full thrust up as is normal during both the abort and ascent mission. The mission controller's ascent and abort missions differ in a crucial way, however. The ascent mission drops weights, the abort mission does not (this difference was not apparent on earlier dives because the hardware deadman and mission timeout were almost coincident in time, or an acoustic abort was issued before mission timeout). The descent following the initial ascent was caused by negative buoyancy. Additional ballast weight had been added prior to this dive after misinterpreting differences in performance while ascending versus descending as ballast-related, rather than trim and drag-related.

Issues and Proposed Solutions

1. Electrical noise appears to be contaminating at least some hydrographic measurements. This issue needs to be addressed. A stop-gap measure for hydrographic surveys would be to fly completely open-loop, with fin angles fixed and thrusters set to constant current command.

2. Trim, pitch control, and fin actuator saturation. These represent a coupled problem that needs further investigation, and will likely require changes to the flight controller and possibly necessitate an increase in size of the aft stabilizer to provide more authority over vehicle pitch. Pitch control was disengaged during this dive, and the dive was flown in level-flight allocation. Using the pitching flight allocation and engaging pitch control may have improved performance—these modes were designed specifically for yoyos—but conservatism drove the choice to fly in level flight allocation with pitch control disengaged.

3. Mission timeout and the abort mission. The abort mission is inappropriate for operation in AUV configuration. A mission timeout should trigger the normal ascent mission. However, this change was *not* made for fear of unintended consequences during the remaining few dives of the cruise in AUV configuration. The abort mission as it currently exists was intended for ROV configuration only, but it needs review.

Chief Scientist Comments

Dive Statistics

Survey start: 2013/06/13 09:27:04
Survey end: 2013/06/13 20:55:59
Ascent begins: 2013/06/13 21:00:36
On the surface: 2013/06/13 22:16:38
On deck: 2013/06/13 22:46:03
descent rate: 23.0 m/min
ascent rate: 27.0 m/min
survey time: 11.5 hours
deck-to-deck time 14.8 hours
Mean survey depth: 2024m
Mean survey height: 15m
distance travelled: 37.94km
average speed; 0.91m/s
average speed during photo runs: 0.82 m/s over 37.23 km
average speed during multibeam runs: 0.83 m/s over 2.54 km
total vertical during survey: 6402m
Battery percent at launch: 93.8
Battery percent at descent end: 91.8
Battery percent at survey end: 17.5
Battery percent on deck: 12.8
Note: Distance traveled numbers are not accurate.

Plots

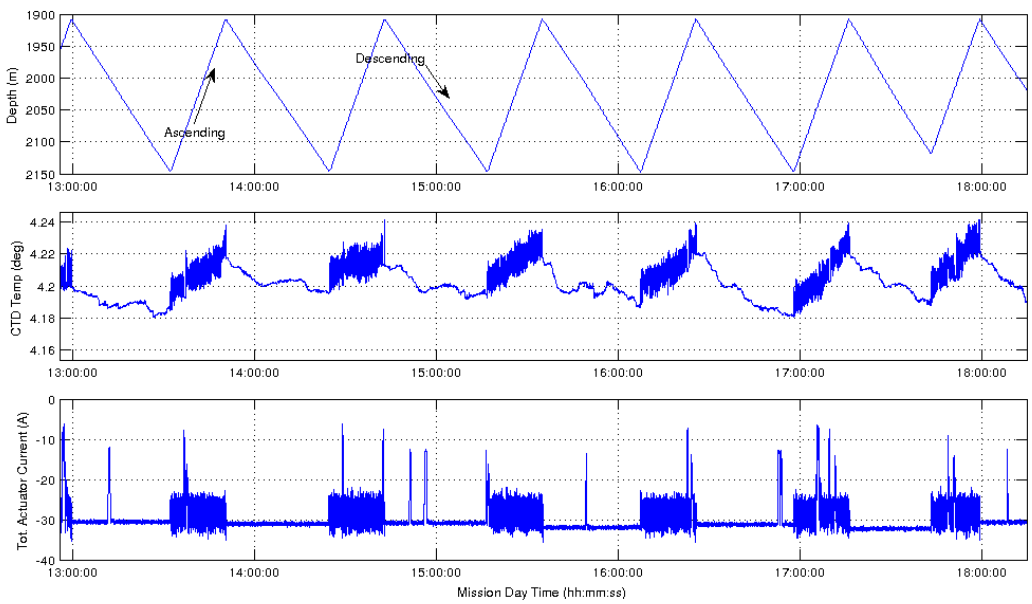


Figure 4: Correlation between ascending vs. descending yoyo legs, CTD noise (in situ temperature), and total current draw by all actuators.

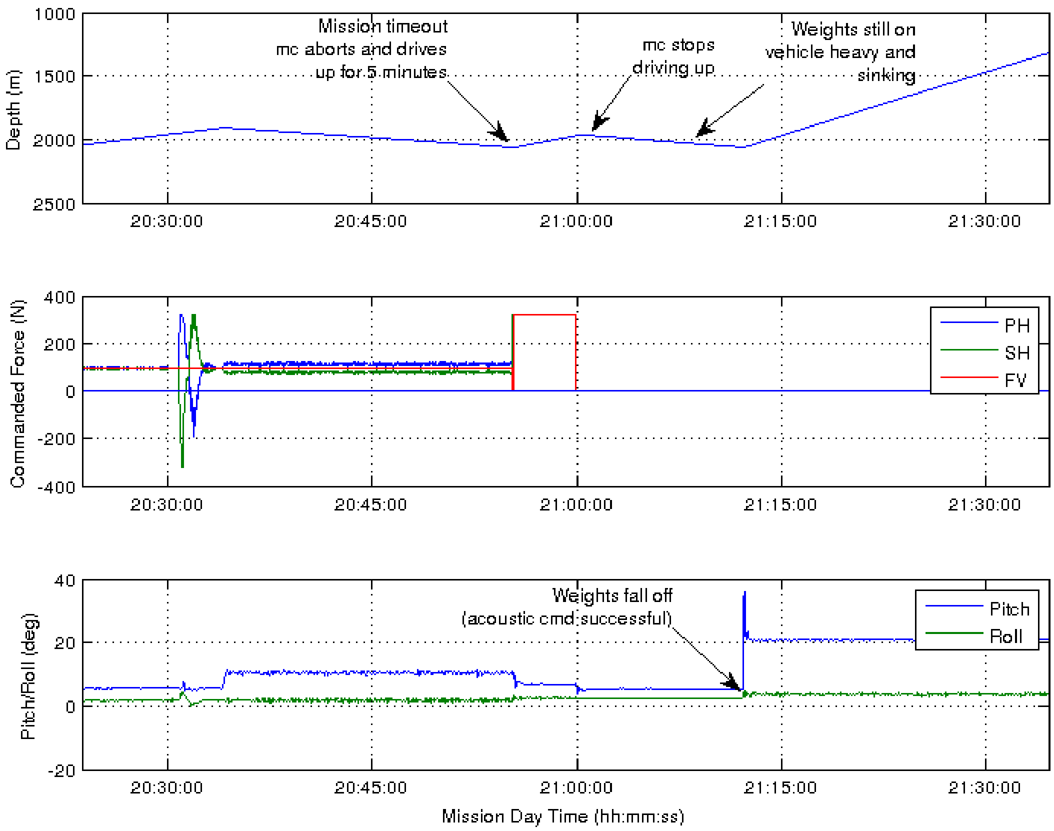


Figure 5: Mission timeout and ascent behavior.

Nereus 053 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

A second dive at Von Damm to obtain additional magnetics data, map the Von Damm mound, and photograph the southern flank of the mound. Magnetic data was obtained both over the mound and to the west, where a magnetic anomaly was observed during Nereus 050. All of the science objectives for this dive were achieved.

Weather: Did not affect operations.

Reason for end of dive: Mission controller timeout to ensure recovery during daylight hours. Vehicle had approximately half a trackline left and 24% battery charge left.

Vehicle Configuration

The science sensing suite for this dive was:

Table 7: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

Launch went fine. There was poor USBL and SMS for the first few hundred meters with the Avtrak being more reliable than the WMT beacon. Oddly, the WMT was providing SMS messages but not providing tracking. Tracking improved after a few hundred meters, however, the reason might be related to the ship's position relative to the beacon (*Nereus* was in the wake of the ship for the first few hundred meters).

Bottom approach was fine and the mission started fine. During the dive, *Nereus* was observed to overshoot the end of the trackline numerous times and acoustic navigation corrections were applied. Bottom following worked very well. Accurate USBL was an issue throughout the dive with the positions varying. This problem was compounded by the inability of the ship to hold station at times and the resulting heading changes resulted in changes in the USBL position. USBL issues combined with the subsea navigation issues (i.e., the observed overshooting of the tracklines) made it difficult to navigate and retask the vehicle. This proved slightly problematic during the camera survey and the camera survey block was not optimally centered. Still, we able to achieve the dive imaging goals along with the magnetic data collection of the western region.

The mission timed out. Because the mission controller does not drop the weights at a mission timeout, an acoustic abort was sent. Descent and recovery was fine.

Issues and Proposed Solutions

1. DVL performance was less than superior on this dive. An analysis of this data (discussed in greater detail in JCK's dvl25mAltPerformanceNotes.txt notes) indicates that there is lots of DVL noise at 25m. This was not observed at other altitudes during the dive (including at 5m) nor during other dives. The root cause is still unknown; for the moment, the only solution is to avoid 25m altitude (a less than satisfying solution).

Dive Statistics

Survey start: 2013/06/14 09:43:11
Survey end: 2013/06/14 20:55:60
Ascent begins: 2013/06/14 21:00:36
On the surface: 2013/06/14 22:05:07
On deck: 2013/06/14 22:59:59
descent rate: 22.7 m/min
ascent rate: 35.9 m/min
survey time: 11.2 hours
deck-to-deck time 15.0 hours
Mean survey depth: 2339m
Mean survey height: 21m
distance travelled: 12.88km
average speed; 0.36m/s
average speed during photo runs: 0.22 m/s over 4.14 km
average speed during multibeam runs: 0.43 m/s over 12.56 km

total vertical during survey: 3139m
Battery percent at launch: 93.2
Battery percent at descent end: 88.6
Battery percent at survey end: 30.8
Battery percent on deck: 23.8
Note: Distance traveled numbers are not accurate.

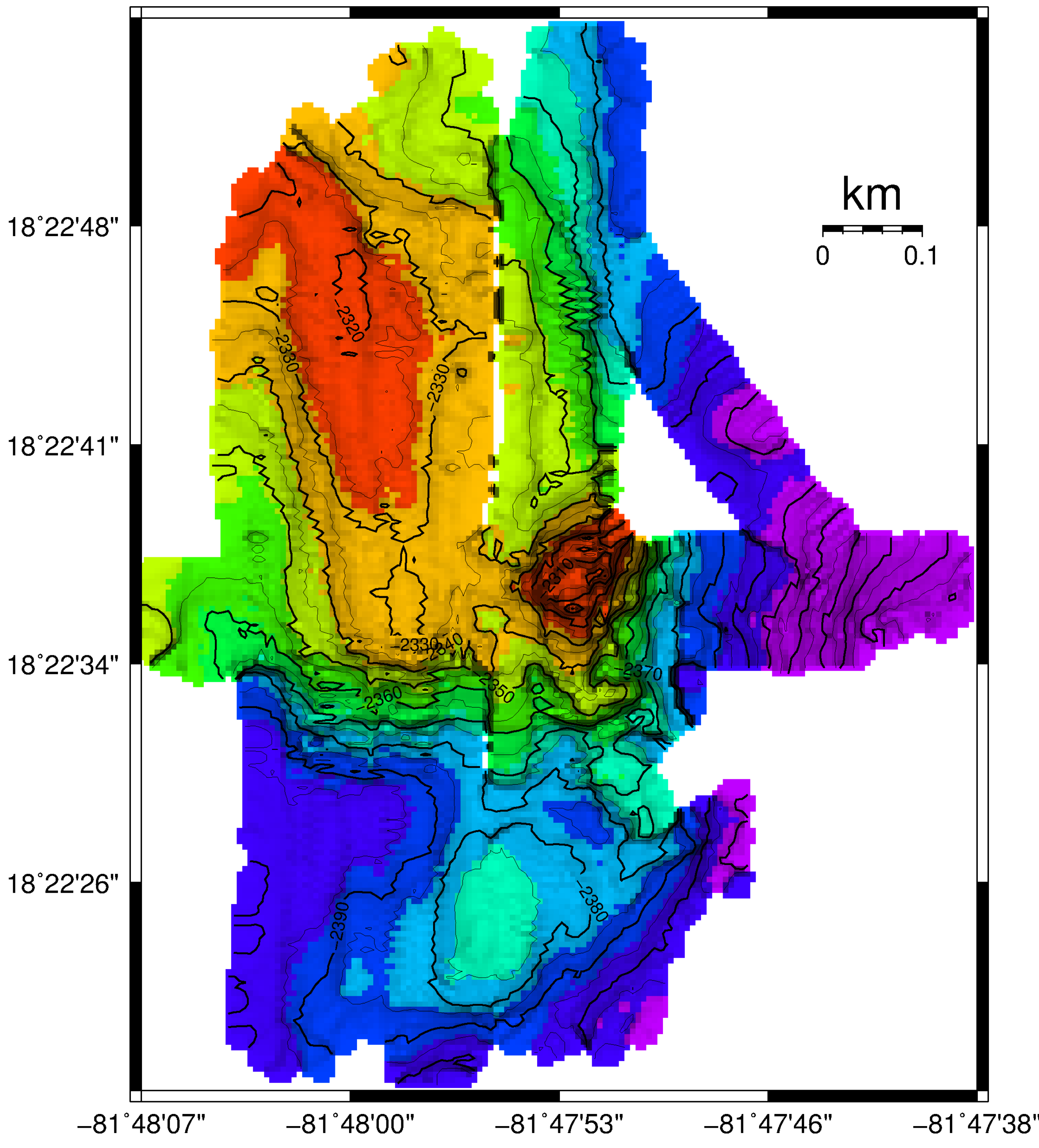


Figure 6: Bathymetry generated during nereus053 with the vehicle's Imagenex 881 mechanically scanned sonar.

Nereus 054 Dive Report

WHOI Nereus Operations Group
Casey Machado, Mario Fernandez, James Kinsey, Daniel Gomez-Ibanez, Michael Jakuba, and Laurel O'Hara

Nereus Expedition Leader: Casey Machado

Chief Scientists: Dr. Christopher German (WHOI)

Summary

40m altitude survey to the west of Nereus 051 searching for the hydrothermal vent activity. 25m and 5m altitude box surveys were added to the end of the mission to allow for retasking if vent activity was found during the dive. Eh and OBS signals suggest the presence of the hydrothermal activity but none of the signals were strong enough to warrant subsequent exploration.

Weather: Did not affect operations.

Reason for end of dive: Abort on low battery.

Vehicle Configuration

The science sensing suite for this dive was:

Table 8: Nereus AUV Sensor Configuration

Sensor
Honeywell Magnetometer
Seabird SBE49 CTD
300kHz RDI DVL
Koichi Nokomura EH sensor
Optical Backscatter Sensor
SUPR Sampler
Transmissometer

This dive was navigated using the DVL/INS system in realtime. USBL provided post-dive corrections. All final navigation tracks are the best effort interpretation of available data by skilled personnel.

Important Positions

Dive Origin: 18.3667°N, 081.8167°W

Narrative

The descent burn wire broke during launch because the descent weight slipped off its line before it was in the water and jerked the burn wire. *Nereus* was swung back inboard and the descent burn wire replaced. This was done without taking down rov or the mission controller, or resetting any of the timers. Descent and bottom approach went fine.

The commanded speed was 1m/s, which *Nereus* achieved for most of the dive, but at the expense of consuming its battery at approximately 10%/hour. Pitch control was enabled approximately 1 hr into the dive in an attempt to improve vehicle pitch and reduce drag. Only P-gain was enabled (WCG 3 5000 0 0). While ascending and flying level vehicle pitch was improved from +10 deg to +2 deg. While descending both fins tended to saturate and vehicle pitch returned to +10 deg. No significant change in battery consumption rate is evident in the logs with pitch control engaged.

After approximately 50% of the 40m alt tracklines, we downloaded a new mission to conduct a 25m survey in the Northeast corner of the mission. The mission was successfully received and *Nereus* retasked. The 25m altitude survey had the same DVL navigation troubles observed on Nereus 053 and 050 — bad DVL velocities at 25m caused errors in the subsea navigation solution. *Nereus* continued surveying at 25m altitude until the batteries dropped below 10% and an abort was triggered.

Ascent and recovery went smoothly. During the ascent we attempted to acoustically command a "Tivey Twist" by sending "CFG 3" and "WRI 3 180: commands; however the abort processes kept resetting to CGF 0 bedeviling our attempts to acoustically spin the vehicle and ultimately preventing us from doing so.

Dive Statistics

Survey start: 2013/06/15 09:57:12
Survey end: 2013/06/15 17:50:06
Ascent begins: 2013/06/15 17:51:58
On the surface: 2013/06/15 19:02:60
On deck: 2013/06/15 19:31:23
descent rate: 22.6 m/min
ascent rate: 31.8 m/min
survey time: 7.9 hours
deck-to-deck time 11.2 hours
Mean survey depth: 2199m
Mean survey height: 40m
distance travelled: 21.37km
average speed; 0.83m/s
average speed during photo runs: 0.28 m/s over 2.10 km
average speed during multibeam runs: 0.83 m/s over 23.45 km
total vertical during survey: 2110m
Battery percent at launch: 96.1
Battery percent at descent end: 91.7

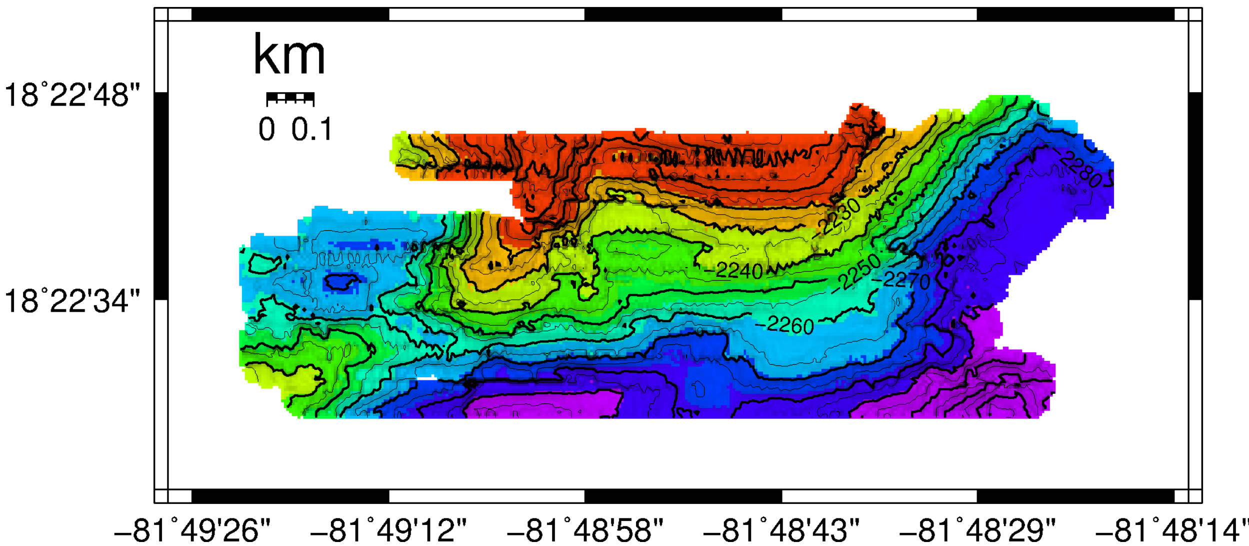


Figure 7: Bathymetry generated during nereus054 with the vehicle's Imagenex 881 mechanically scanned sonar.

Battery percent at survey end: 10.0
Battery percent on deck: 6.2
Note: Distance traveled numbers are not accurate.

OASES 2013
Dive Plan for Nereus 055

Prime Objective: Sampling at Von Damm

1. Dive direct to East Summit of Von Damm spire (226°C Fluids site) at ~2300m.
[X = 1982, Y = 1103; depth = 2291m]

2. Collect up to 100 shrimp using slurp suction sampler (if that many fit in chamber) for Max & Cindy.

3. Find/create good vent orifice, record temperatures (target >200°C) and take 2 x IGT fluid samples (Jeff).

4. Collect complementary microbio (SUPR) sample for Julie at same location.

5. Collect high quality video footage before leaving top of Spire (Chris).

6. Drive south in mid-water off the top of the Von Damm mound in the direction of Marker X-18 (tube-worm and whale bone site) [X = 2041, Y = 892; depth = 2376m]

7. Inspect whale-bone experiment for evidence of Osedax colonization (Cindy).

8. Head short distance (10m?) north & east to "Shrimp Hole" site for microbio (SUPR) sample for Julie (IGT temperature in 2012 was 21°C)
[Jason 2012 Coordinates: X = 2039, Y = 892; depth = 2374m]

9. Continue uphill (NNW approx.) toward Old Man Tree, as time allows to:
a) Check temperatures using IGT probes at other diffuse flow sites including:-
- Hot Cracks #1 & #2 [X = 2028-35, Y = 915-918; depth = 2372m]
- Old Man Tree [X = 2011, Y = 914; depth = 2373m]
b) Collect additional microbio samples for Julie, as required, based on T° readings

10. Continue NNE from Old Man Tree toward targets from Nereus 053 photo-survey to
a) Search for and collect live mussels if we can find any.
b) Visit/inspect sites with dense tube-worm colonies.

11. If time/power allows, continue north, up the southern face of the Von Damm cone to return to the central Von Damm spire; collect additional video and end dive.

OASES 2013
Dive Plan for Nereus 056

Prime Objective: Sampling at Von Damm

1. Dive direct to East Summit of Von Damm spire (226°C Fluids site) at ~2300m.
[X = 1982, Y = 1103; depth = 2291m]

2. Find/create good vent orifice (target >200°C) and take 2 x IGT fluid samples (Jeff).

3. Drive south in mid-water off the top of the Von Damm mound in the direction of Marker X-18 (tube-worm and whale bone site) [X = 2041, Y = 892; depth = 2376m]

4. Inspect whale-bone experiment for evidence of Osedax colonization (Cindy).

5. Head short distance (10m?) north & east to "Shrimp Hole" site for microbio (SUPR) sample for Julie (IGT temperature in 2012 was 21°C)
[Jason 2012 Coordinates: X = 2039, Y = 892; depth = 2374m]

6. Slurp for up to 100 "sparse" shrimp anywhere along this transect

7. Continue uphill (NNW approx.) toward Old Man Tree, and:
a) Check temperatures using IGT probes at other diffuse flow sites including:-
- Hot Cracks #1 & #2 [X = 2028-35, Y = 915-918; depth = 2372m]
- Old Man Tree [X = 2011, Y = 914; depth = 2373m]
b) Collect additional microbio samples for Julie, as required, based on T° readings

8. Continue NNE from Old Man Tree toward targets from Nereus 053 photo-survey to
a) Search for and collect live mussels if we can find any.
b) Visit/inspect sites with dense tube-worm colonies and collect good video.

9. If time/power allows, continue north, up the southern face of the Von Damm cone to return to the central Von Damm spire; collect additional video and end dive.

OASES 2013
Dive Plan for Nereus 058

High Temperature Sampling at Beebe Vents

1. Approach bottom to North of Piccard Hydrothermal Field

2. Head to Beebe Vent #1
[X=3357, Y=5163; Depth = 4958m]

3. Collect 2 x Hi-T end-members using IGTs from Beebe Vent #1
[Best to sample from E or NE: Nereus on Heading 225-270]

4. Conduct SUPR Plume Sampling above Beebe Vent #1 [Chip]

5. Proceed ESE to Shrimp Gulley (Beebe Sea Mound)
[X=3413, Y=5154; Depth = 4940m]

6. Collect up to 100 shrimp via Slurp for Max & Cindy

7. Check feasibility of taking SUPR samples from Shrimp Gulley (length of SUPR wand)

8. Conduct kick-ass photography at Shrimp Gulley

9. If you didn't break everything else yet, drive to Beebe Woods and image that.
[X=3369, Y=5111; Depth = 4965m]

OASES 2013
Dive Plan for Nereus 059

Low Temperature Sampling at Piccard & IGT-5 / Glassy Basalt sampling

1. Approach bottom to North of Piccard Hydrothermal Field

2. Head to Hot Chimlets area
[Jason 2012 coordinates: X=3359, Y=5221; Depth = 4988m]

3. Collect 2 x IGTs fluid samples (Jeff)

4. Collect 3 or 4 x SUPR-microbiology samples (Julie)

5. Head West to search for IGT-5 left behind in 2009 (Jeff)
[Nereus 2009 coordinates: 18.55027390°N, 81.72196198°W]

6. Recover any Oases markers found on seafloor (Chris)
[Nereus 2009 coordinates:18.54692841°N, 81.72389221°W]

7. Keep a look out for fresh glassy basalt (Max)

OASES 2013
Dive Plan for Nereus 060

Prime Objective: Low-Temperature Sampling at Von Damm

1. Dive to Marker X-18 to the south of the Von Damm spire (tube-worm and whale bone site) [Jason 2012 coordinates: X = 2041, Y = 892; depth = 2376m]

2. Inspect whale-bone experiment for evidence of Osedax colonization (Cindy).

3. Deploy "Infinity Project" planet (Chris) and photograph it.

4. Locate diffuse flow site with "seep" microbes at X-18 and sample again for Jluie.
[Jason 2012 Coordinates: X = 2044, Y = 893; depth = 2376m]

5. Swing by "Shrimp Hole" (IGT temperature in 2012 was 21°C)
[Jason 2012 Coordinates: X = 2039, Y = 892; depth = 2374m]

6. Slurp for up to 100 "sparse" shrimp anywhere along this transect

7. Continue uphill (NNW approx.) toward Old Man Tree, and:
a) Check temperatures using SUPR: T-probe at other diffuse flow sites including:-
- Hot Cracks #1 & #2 [J2012: X = 2028-35, Y = 915-918; depth = 2372m]
- Old Man Tree [J2012: X = 2011, Y = 914; depth = 2373m]
b) Collect additional microbio samples for Julie, as required, based on T° readings
c) Collect 2 x IGT samples at some point along the way (or later)

8. Continue NNE from Old Man Tree toward targets from Nereus 053 photo-survey to
a) Search for and collect live mussels if we can find any.
b) Visit/inspect sites with dense tube-worm colonies and collect good video.

9. As time/power allows, continue north, up the eastern face of the Von Damm cone to reconnoitre other potential sampling sites for Dive 061 and test using SUPR T-probe.
a) Ravelin #2 [J2012: X = 2068, Y = 941, Z = 2387m]
b) Ravelin #1 [J2012: X = 2048, Y = 949, Z = 2383m]
c) Arrow Loop #1 [J2012: X = 1983, Y = 1103, Z = 2308m]
d) Ginger Castle [J2012: X = 1981, Y = 1135, Z = 2308m]
e) White Castle [J2012: X = 1972, Y = 1138, Z = 2306m]

10. Finally, circle around to the south, still climbing upward, to the central Von Damm spire & collect additional video to end the dive.

OASES 2013
Dive Plan for Nereus 061

Prime Objective: Cleaning Up at Von Damm

1. Dive to the northern side of Von Damm spire.

2. Take 2 x IGT samples (Jeff) at one of:
a) White Castle [J2012: X = 1972, Y = 1138, Z = 2306m]
b) Ginger Castle [J2012: X = 1981, Y = 1135, Z = 2308m]

3. Check with Julie if she would like SUPR-Micro samples at this site

4. Spiral out to East then South around EastFlank of Von Damm Spire to reach Hot Cracks sites #1 and #2 to sample for SUPR Micro for Julie.

5. Proceed to Target 17 on DVL Nav to slurp for 10 or more "sparse" shrimp for Max.

6. Check for mussels for Cindy near
a) Ravelin #2 [J2012: X = 2068, Y = 941: **Depth = 2387m, HDG = 104° / T = 115°C]**
b) Ravelin #1 [J2012: X = 2048, Y = 949; **Depth = 2383m, HDG = 330° / T = 145°C**]
Slurp sample if required.

7. Continue up-slope from Ravelin #1 to unsampled site on spur, NW from Old Man Tree to check whether Julie wants to sample.

8. Head back to "Best Bet for Mussels" site to sample with Slurp for Cindy.

9. Proceed north to site just East of Von Damm spire (Arrow Loops) to check whether Julie wants to sample.

10. If Julie didn't fill SUPR yet, return to
a) Ginger Castle [J2012: X = 1981, Y = 1135, Z = 2308m / **T = 125°C**]
b) White Castle [J2012: X = 1972, Y = 1138, Z = 2306m / **T = 151°C**]

11. If time allows, return to summit for Brennan Philips.

OASES 2013
Dive Plan for Nereus 062

Prime Objective: Low-T Sampling at Piccard

1. Dive to the northern side of Piccard Hydrothermal Field

2. Proceed to Hot Chimlet site and place Planet in situ on metalliferous hard ground (orange).

3. Contour to right / downhill slightly to locate additional sites (target 80°C)

4. Collect complementary SUPR Micro samples for Julie.

5. If that didn't work, progress uphill to South over abundant diffuse flow sites.

6. Find somewhere else good for IGTs.

7. Find multiple other sites for Julie.

8. Proceed to Beebe Woods to collect sparse shrimp from base of chimneys.

9. Collect pretty imagery of Beebe Woods vent-site
    - sparse shrimp at base of chimneys
    - images of the chimneys themselves

10. Video transect for Brennan Phillips above Beebe Woods to come home.

OASES 2013
Dive Plan for Nereus 063

Cleaning Up at Piccard

1. Dive to the northern side of Piccard Hydrothermal Field

2. Pass by Hot Chimlet unless Jeff shouts “Stop”

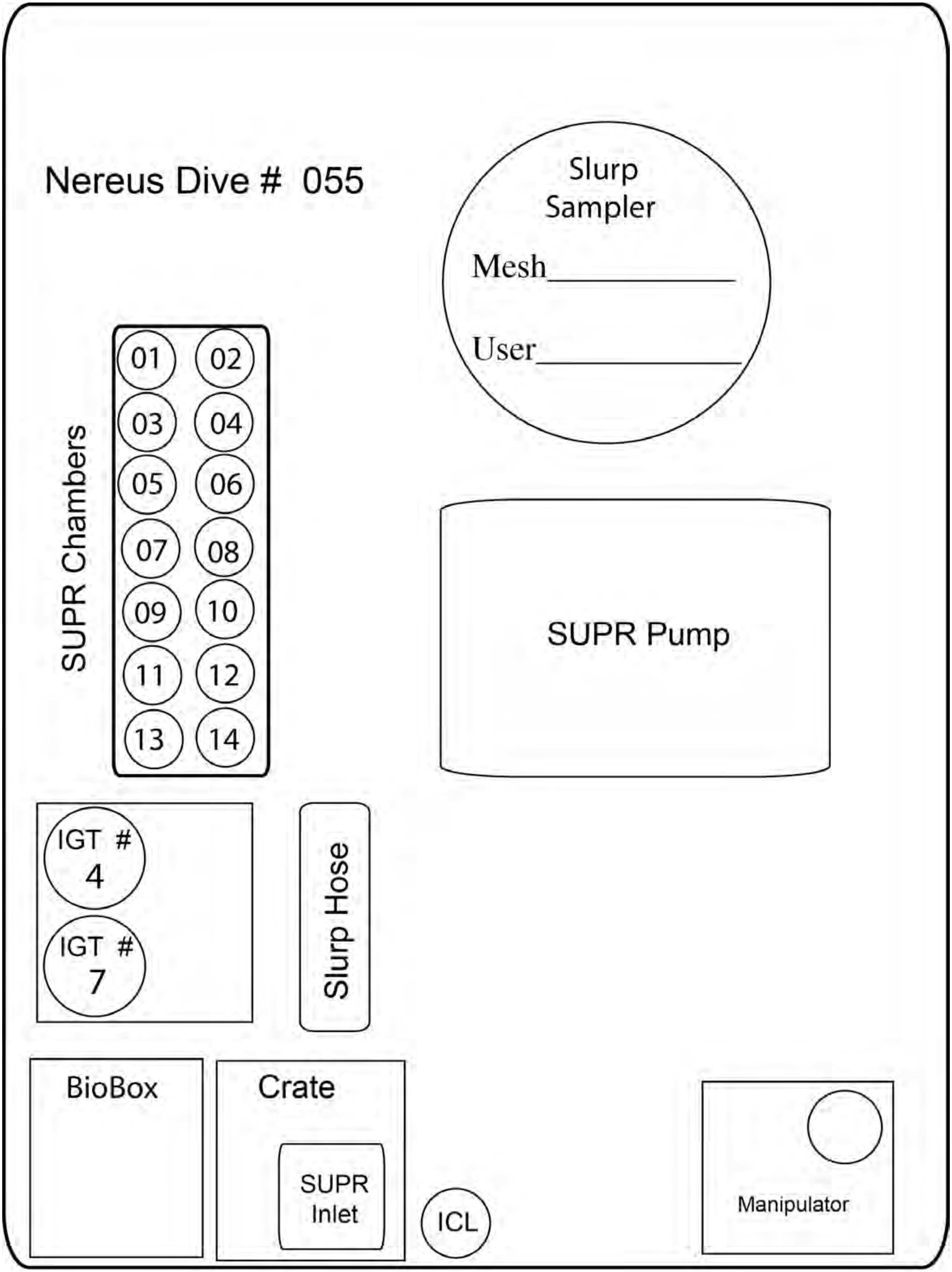
3. Pick up a furry rock and place in BioBox

4. Proceed to Beebe Vents and conduct Chip’s SUPR sampling in plume.

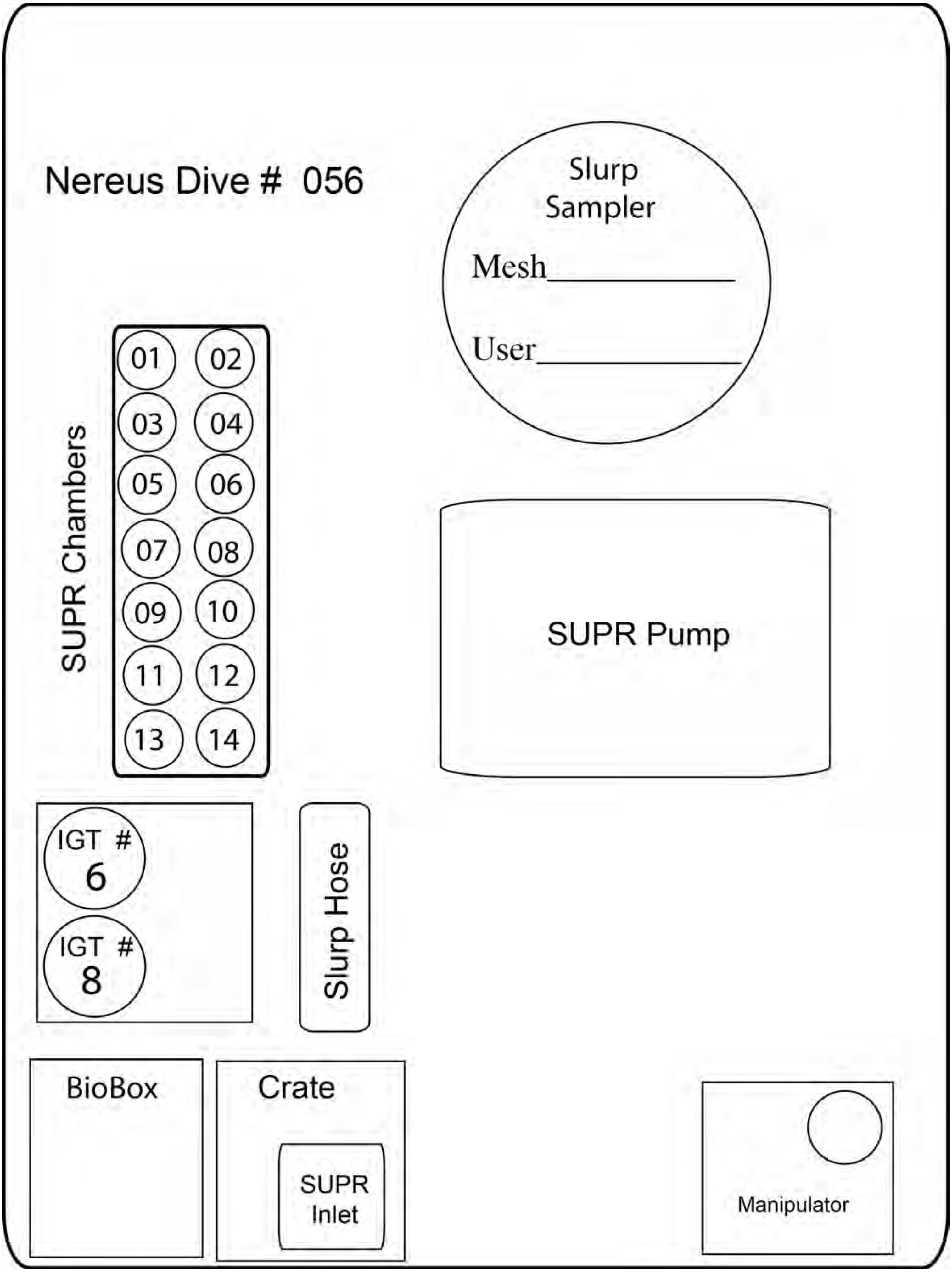
5. Proceed to Beebe Woods to collect sparse shrimp from base of chimneys (Max).

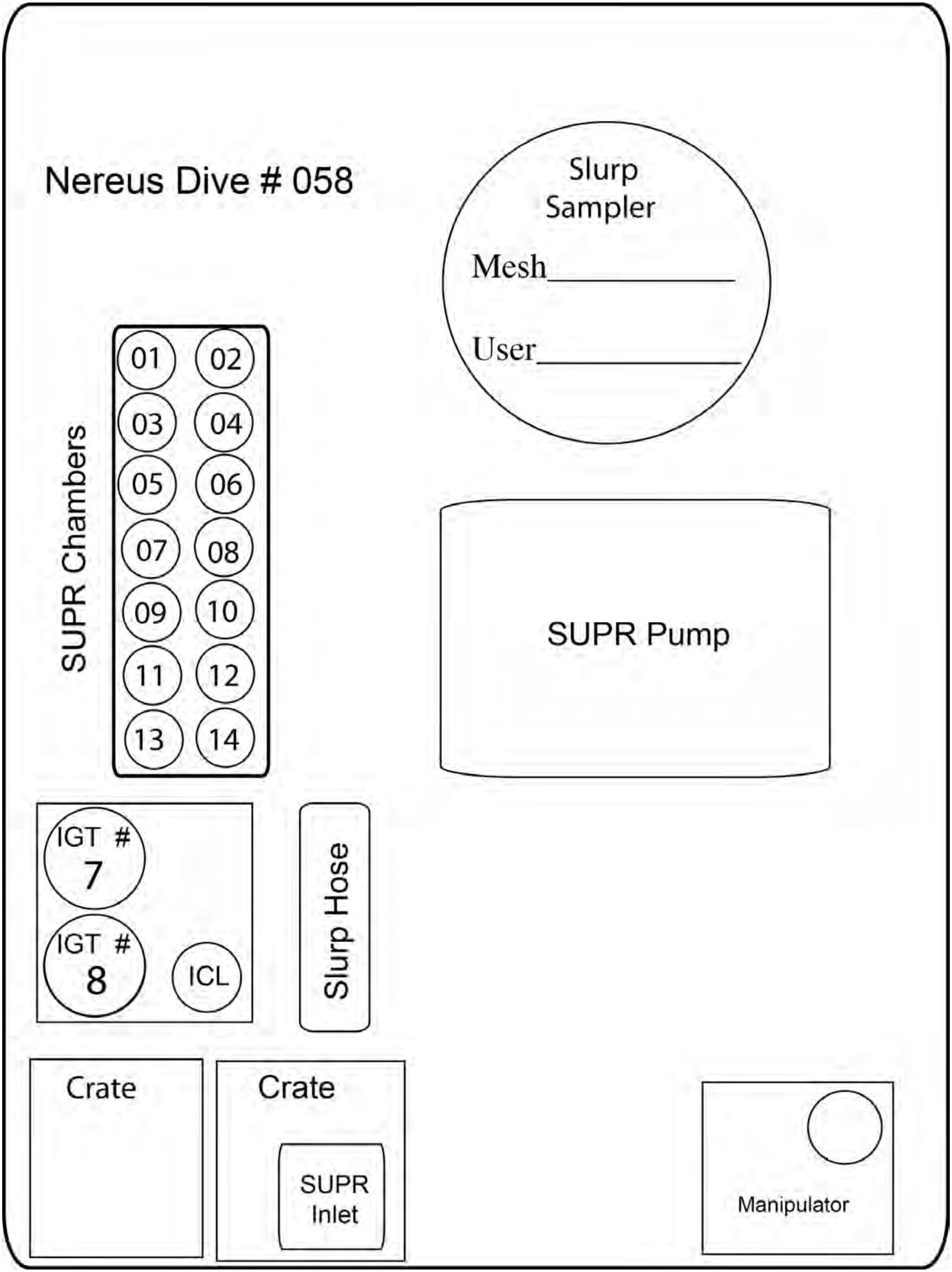
6. Collect pretty imagery of Beebe Woods vent-site (Chris)
    - sparse shrimp at base of chimneys
    - images of the chimneys themselves

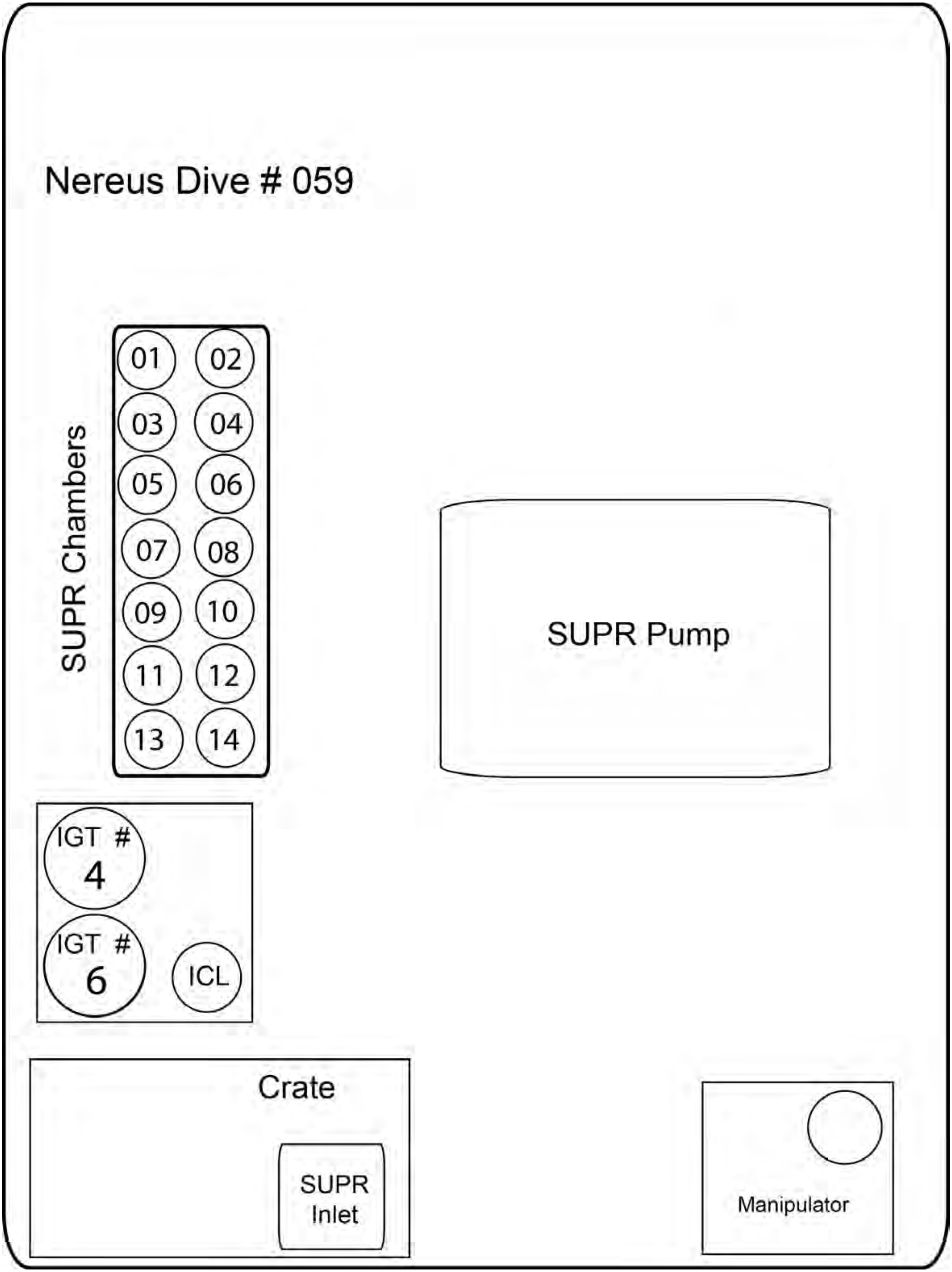
7. Continue to Beebe Sea mound to collect 2 x IGT fluid samples.

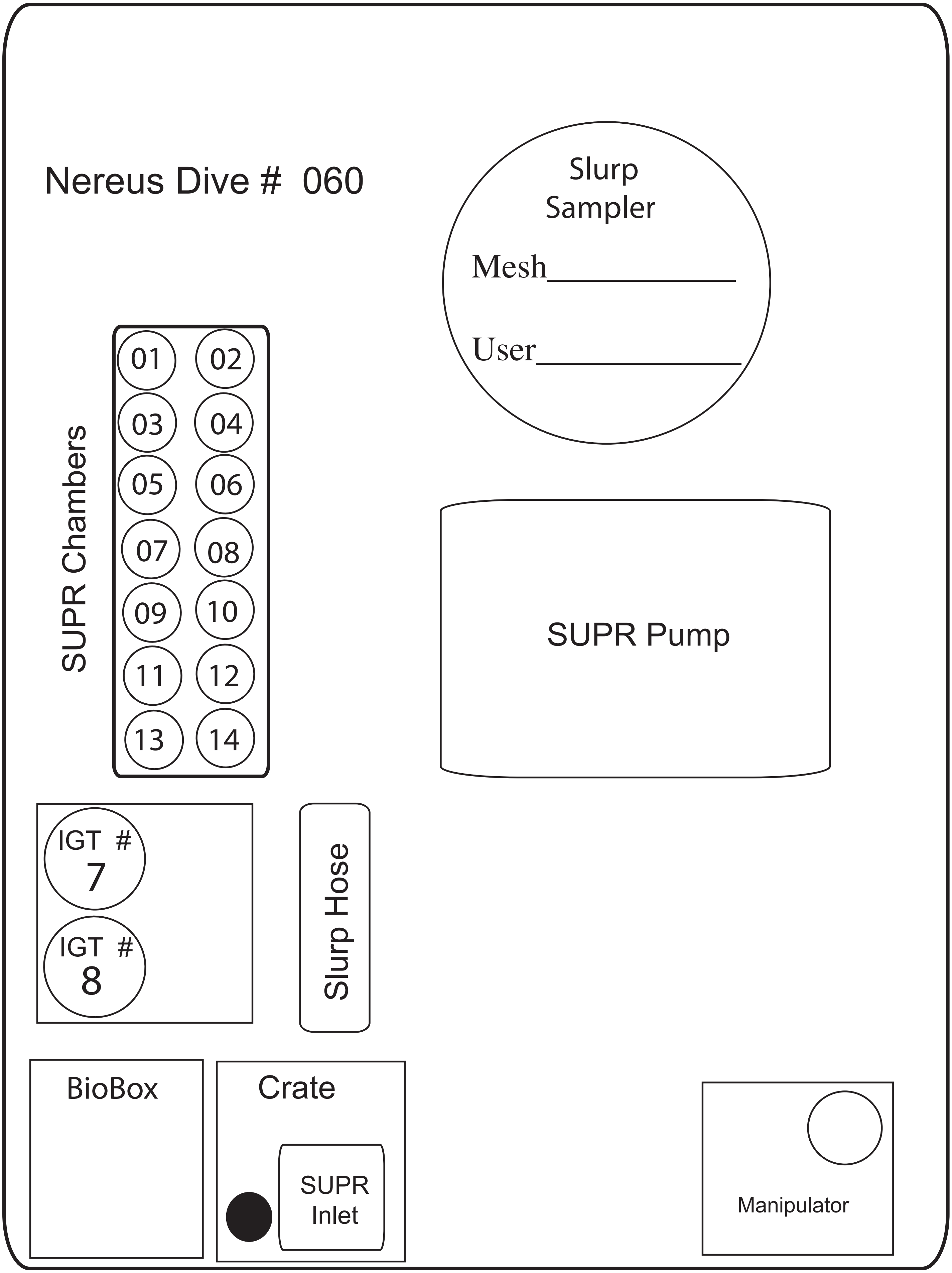

Nereus Dive # 055
Slurp Sampler
Mesh
User
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT # 4
IGT # 7
Slurp Hose
BioBox
Crate
SUPR Inlet
ICL
Manipulator

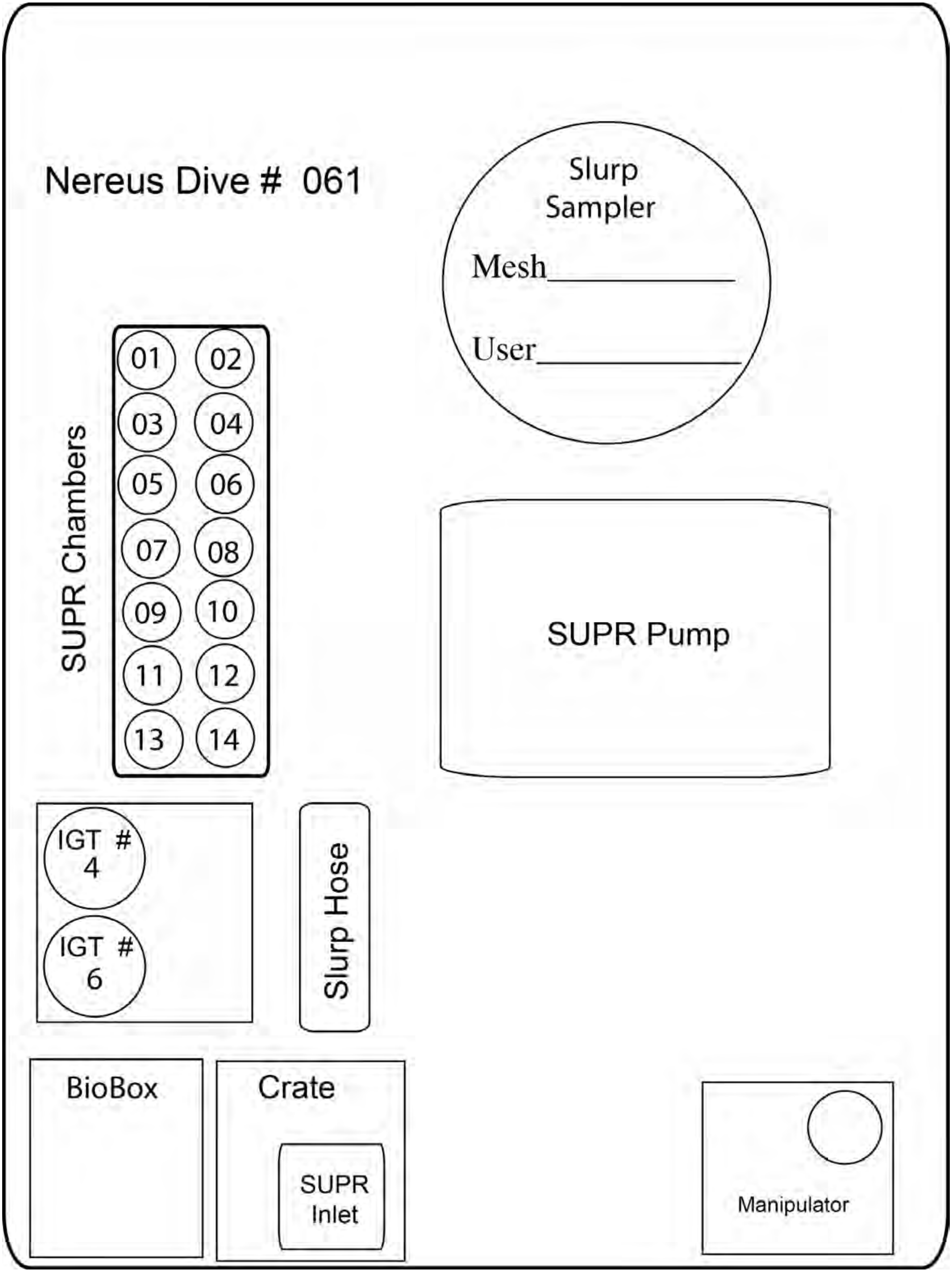
Nereus Dive # 056

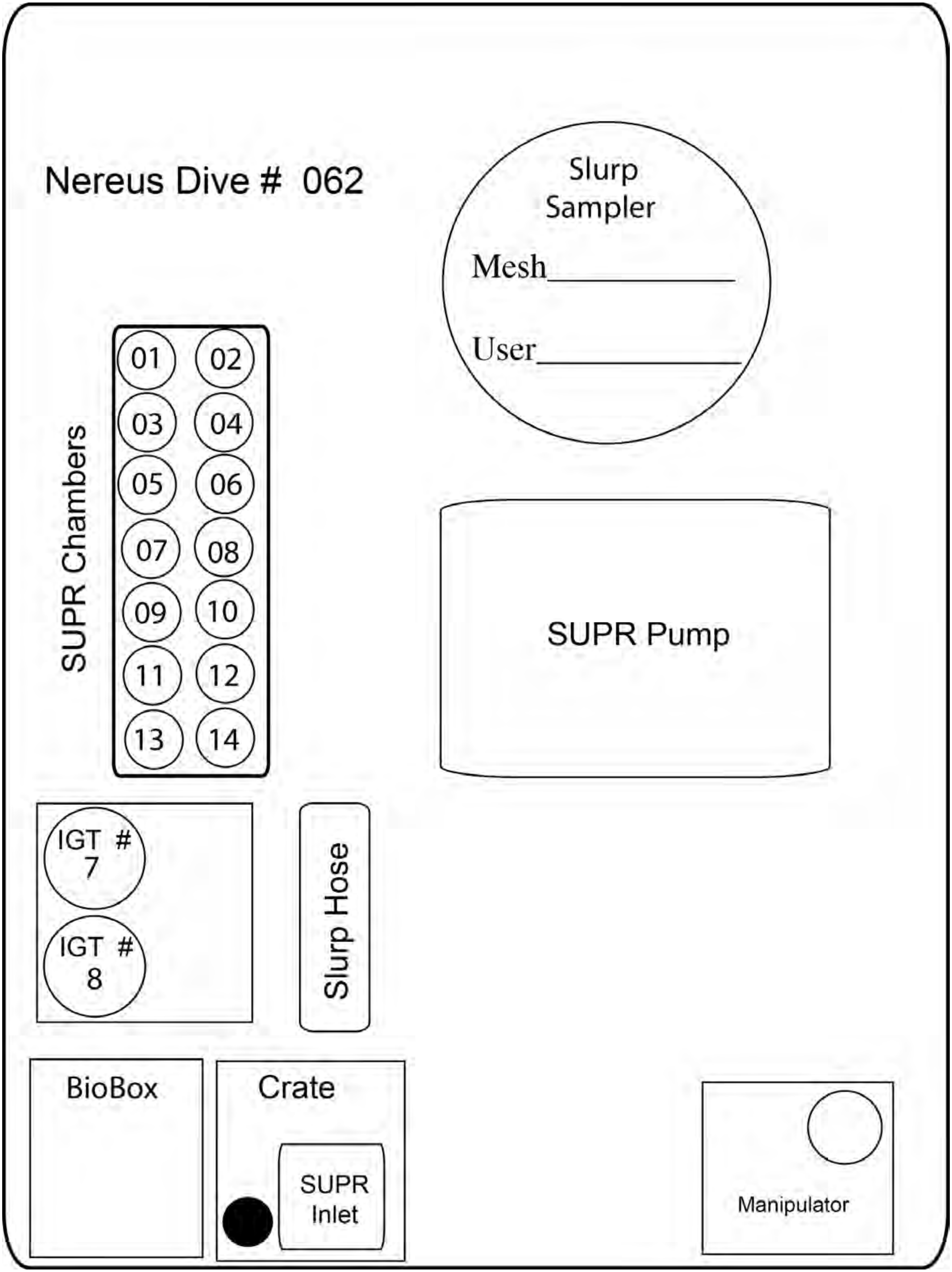



Nereus Dive # 058
Slurp
Sampler
Mesh
User
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT #
7
IGT #
8
ICL
Slurp Hose
Crate
Crate
SUPR
Inlet
Manipulator

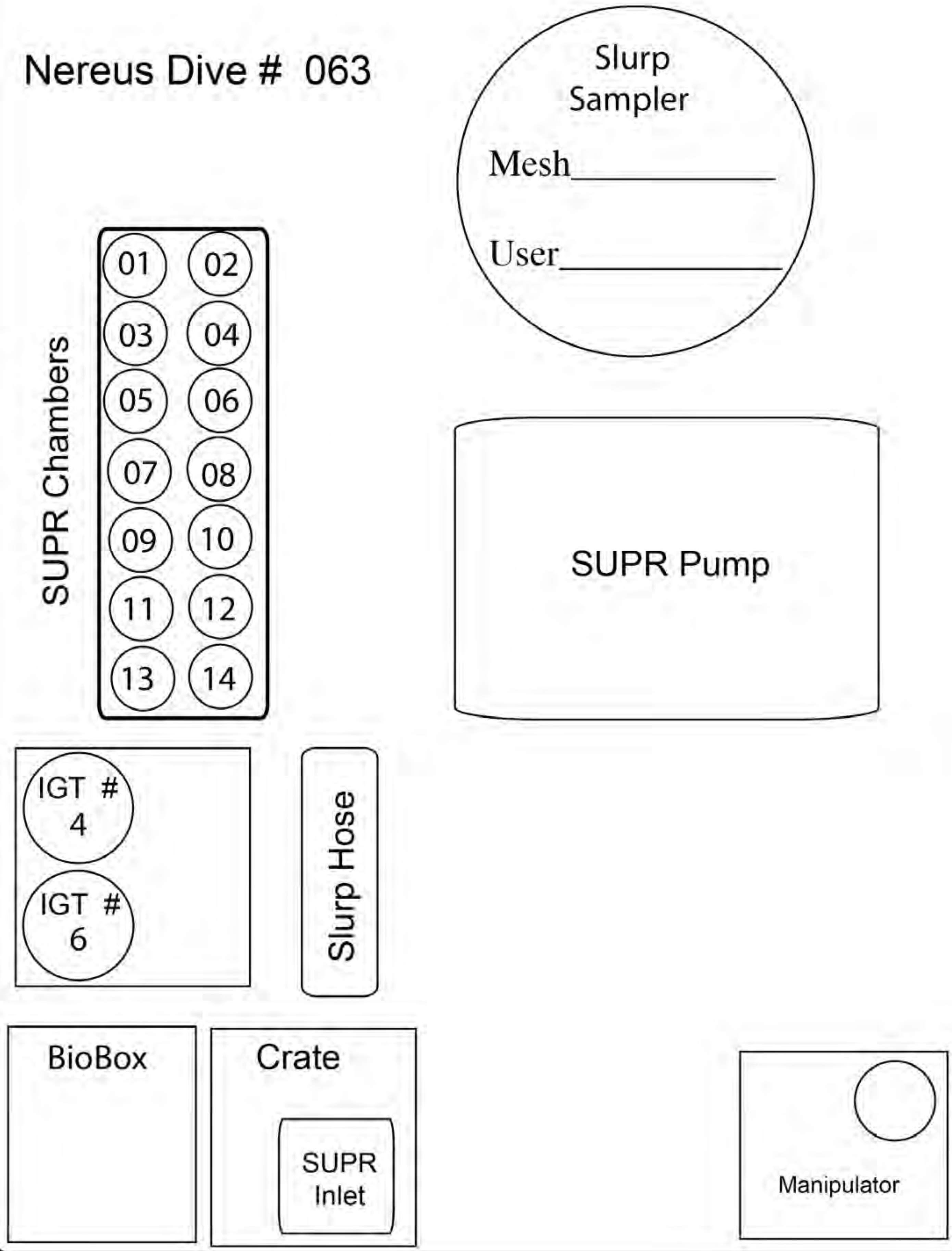

Nereus Dive # 059
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT # 4
IGT # 6
ICL
Crate
SUPR Inlet
Manipulator


Nereus Dive # 060
Slurp Sampler
Mesh
User
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT # 7
IGT # 8
Slurp Hose
BioBox
Crate
SUPR Inlet
Manipulator


Nereus Dive # 061
Slurp Sampler
Mesh____________
User____________
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT # 4
IGT # 6
Slurp Hose
BioBox
Crate
SUPR Inlet
Manipulator


Nereus Dive # 062
Slurp Sampler
Mesh____________
User____________
SUPR Chambers
01
02
03
04
05
06
07
08
09
10
11
12
13
14
SUPR Pump
IGT # 7
IGT # 8
Slurp Hose
BioBox
Crate
SUPR Inlet
Manipulator

Nereus Dive # 063



Nereus Dive #:- N- 055

OASES 2013

Name of Site: Von Damm

Sheet #:- 1

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription
17:51:00	172	01	Slurp	1974	1106	267	2292	Max/Cindy	Great :)
18:13:00	172	02	IGT-4	1971	1103	293	2287	Jeff	Tem range 18-215°C (raw)
19:25-19:30	172	03	SUPR-2	1970	1099	312	2294	Julie	Whole water SE Flank of Spire
19:31-19:35	172	04	SUPR-1	1970	1099	310	2293	Julie	Sterivex filter, SE Flank of Spire
19:38-19:42	172	05	SUPR-3	1970	1100	306	2293	Julie	Whole water SE Flank of Spire
19:45-19:55	172	06	SUPR-4	1970	1100	306	2293	Julie	Sterivex filter, SE Flank of Spire
19:56-19:59	172	07	SUPR-6	1970	1100	301	2293	Julie	Whole water SE Flank of Spire
20:02-20:11	172	08	SUPR-13	1970	1100	300	2293	Chip	Whole water + Capsule
20:23-20:40	172	09	SUPR-14	1959	1106	140	2293	Chip	Whole water + Capsule
									.

Nereus Dive #:- N- 056 | OASES 2013 | Name of Site: Von Damm

Sheet #:- 1

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription
14:51:00	22-Jun	01	IGT-6	*1849*	*1882*	235	2287	Seewald	No good T readings; XY OK?
									.

Nereus Dive #:- N- 058

OASES 2013

Name of Site: Piccard

Sheet #:- Samples

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription
15:30?	175	01	Rock	3355	5183	106	4952	Coleman	Sulfide Fragments in Crates from base of Beebe Vent #1
16:56:00	175	02	IGT7	3371	5231	012	4955	Seewald	320-325°C fluids from Beebe Vent 4
17:08:00	175	03	IGT8	3374	5167	010	4955	Seewald	398°C fluids from Beebe Vent 4
17:34:00	175	04	SUPR#03	3379	5167	008	4955	Breier	Background @ BV4 site
17:38:00	175	05	SUPR#04	3397	5145	008	4955	Breier	Background @ BV4 site
17:46:00	175	06	SUPR#05	3421	5116	008	4955	Breier	~50°C, right above BV4
17:51:00	175	07	SUPR#06	3428	5107	008	4955	Breier	~50°C, right above BV4
17:57:00	175	08	SUPR#07	3446	5086	008	4955	Breier	~12°C, 1m above BV4
18:01:00	175	09	SUPR#08	3373	5156	006	4955	Breier	~12°C, 1m above BV4
18:12:00	175	10	SUPR#09	3372	5157	029	4950	Breier	~6°C, 5m above BV4
18:15:00	175	11	SUPR#10	3373	5159	347	4950	Breier	~6°C, 5m above BV4
18:21:00	175	12	SUPR#11	3373	5157	339	4945	Breier	~5°C, 10m above BV4
18:30:00	175	13	SUPR#12	3367	5143	193	4945	Breier	~5°C, 10m above BV4
19:08:00	175	14	BIO	3455	5163	056	4959	Coleman & Van	Shrimp @ NHM (Feb'13) marker [Diva Amon]
19:15-19:25	175	15	Video	3354	5183	056	4959	Phillips/Van Do	Video-Transect (Port and Straboard Inner Hull Lights on only; Wider Angle Cameron HD camera used)
									.

Nereus Dive #:- N- 059

OASES 2013

Name of Site: Piccard

Sheet #:- 1

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription		
13:37:00	176	01	Video				4992	German	Whale Bone HDTV for Adrian Glover & Diva Amon		
13:54:00	176	02	Video				4996	German	Close up of Hot Chimlet		
14:27:00	176	03	Video	3296	5213	066	4984	German	Close up of Hot Chimlet		
14:48:00	176	04	IGT-4	3190	5182	107	4984	Seewald	~85°C		
15:03:00	176	05	IGT-6	3127	5192	108	4984	Seewald	≤79°C		
15:18-15:27	176	06	SUPR-01	2983	5214	108	4984	Huber	Whole water at Hot Chimlet		
15:28-15:42	176	07	SUPR-02	3365	5226	108	4985	Huber	Sterivex Filter at Hot Chimlet		
15:44-15:51	176	08	SUPR-03	3365	5226	108	4985	Huber	Whole water at Hot Chimlet		
17:22:00	176	09	IGT-5				4921	Seewald	Titanium-rich Installation Art-piece		
									.		

Nereus Dive #:- N- 060 OASES 2013 Name of Site: Von Damm

Sheet #:- 1 2

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription		
11:13:00	177	01	Video	2054	889		2372	Van Dover	Bone bag video		
12:40:00	177	02	Video				2372	Van Dover	Bone bag video		
13:29-13:35	177	03	SUPR-01	2056	894	063	2372	Huber	Whole Water (Tmax ~13°C)		
13:36-14:06	177	04	SUPR-02	2056	894	063	2372	Huber	Stervivex Filter (Tmax ~25°C)		
14:06-14:14	177	05	SUPR-03	2056	894	063	2372	Huber	Whole Water (Tmax = 29•C)		
14:21-14:22	177	06	Video	2056	894	065	2372	German	Video of flow at X-18 flow-site		
14:34:00	177	07	Planet	2055	894	078	2372	German	Planet deployed @ X-18 flow-site		
15:00-15:05	177	08	Video	2048	926	115	2369	German	Twin Peaks Video		
15:06:00	177	09	Temperature	2046	925	132	2369	German	123°C on T-probe		
15:22-15:25	177	10	Video	2046	925	132	2369	German	More video of fluid flow		
15:54:00	177	11	IGT-7	2046	926	134	2369	Seewald	Tmax 138°C		
16:24:00	177	12	IGT-8	2046	925	130	2369	Seewald	Tmax 138°C		
17:03-17:23	177	13	SUPR-04	2045	921	082	2369	Huber	Stervivex Filter (Tmax 141°C)		
17:24-17:31	177	14	SUPR-05	2046	923	097	2369	Huber	Whole Water (Tmax 140°C)		

Nereus Dive #:- N- 060

OASES 2013

Name of Site: Von Damm

Sheet #:- 1 2

17:46:00	177	15	Slurp	2054	913	101	2369	Van Dover	10 Sparse Shrimp @ Twin Peaks into single slurp chamber		
17:52:00	177	16	Slurp	2056	914	101	2369	Coleman	25 Sparse Shrimp @ Twin Peaks into single slurp chamber		
18:04:00	177	17	Slurp	2060	913	349	2369	Coleman	15 Sparse Shrimp north of Twin Peaks into single slurp chamber		
19:20:00	177	18	Video	1981	1089	019	2289	German	Spire Zoom		
19:29:00	177	19	Video	1973	1089	053	2290-2890	Phillips/Van Dove	Zooplankton vertical transect		
									.		

Nereus Dive #:- N- 061
Sheet #:- 1 2

OASES 2013

Name of Site: Von Damm

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription		
12:25:00	178	01	Temp	1976	1129	152	2305	German	Ambient, 4.8°C, Tmax = 7.5°C		
12:28:30	178	02	Video	1974	1126	152	2305	German	Video of Shrimp in Fish-Cave		
12:34:26	178	03	Temp	1977	1127	116	2304	German	6°C below boulder		
12:40:00	178	04	Temp	1977	1126	110	2304	Huber	61°C Tmax: Shrimp Buttery		
13:19-13:25	178	05	SUPR 01	1980	1129	171	2304	Huber	Whole-water, Tmax ~131°C		
13:26-13:47	178	06	SUPR 02	1982	1129	201	2304	Huber	Sterivex Filter, Tmax ~130°C, 75-100°C during sampling		
13:54:00	178	07	Temp	1982	1128	214	2303	Seewald	Tmax in Vent 1 = 144*C		
13:59:00	178	08	Temp	1982	1128	217	2303	Seewald	Tmax in Vent 2 = 123°C		
14:06:00	178	09	IGT-4	1982	1128	218	2303	Seewald	Tmax 141°C		
14:16:00	178	10	IGT-6	1981	1128	220	2303	Seewald	Tmax 146°C: Bartizan		
14:46:00	178	11	Video	1984	1124	288	2303	German	Bartizan video		
15:46-15:53	178	12	SUPR 03	2028	911	255	2369	Huber	Whole water		
15:33-16:23	178	13	SUPR 04	2028	911	256	2369	Huber	Sterivex Filter		
16:23-16:30	178	14	SUPR 05	2023	914	257	2368	Huber	Whole Water		

Nereus Dive #:- N- 061
Sheet #:- 1 2

OASES 2013

Name of Site: Von Damm

16:37-17:23	178	15	Slurp	2023	914	257	2368	ın Dover/Colemı	65 shrimp		
18:04-18:24	178	16	SUPR 06	2021	921	274	2370	Huber	Sterivex, Tmax = 114°C		
18:25-18:29	178	17	SUPR 07	2021	921	273	2370	Huber	Whole water, Tmax = 111°C		
18:29-18:31	178	18	SUPR 09	2021	9290	274	2370	Huber	Whole water, Tmax = 109°C		
19:27:00	178	19	Video	2038	942	311	2380	German	Ravelin #2 vent-site		
19:44:00	178	20	Video	2039	950	320	2370	German	Galatheid & Spooky Shrimp		
19:50:00	178	21	Video	2037	950	322	2368	Van Dover	Mussels (DVL Target #13)		
20:28:00	178	22	Video					German	Von Damm Spire		
20:33:00	178	23	Video					Phillips	Vertical Transect		

Nereus Dive #:- N-062

OASES 2013

Name of Site: Piccard

Sheet #:- 1 2

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription	
13:58:00	179	01	Temp	3373	5231	216	4986	German	Tmax 22°C	
14:10:00	179	02	Temp	3374	5230	235	4985	German	Tmax 18°C	
14:21:00	179	03	Infinity	3376	5228	206	4984	German	Infinity Project @ Hot Chimlet	
14:31:00	179	04	Infinity	3376	5228	200	4984	German	Zoomed Focus #1	
14:33:00	179	05	Infinity	3376	5228	200	4984	German	Zoomed Focus #2	
14:40:00	179	06	Infinity	3376	5228	200	4984	German	Wide View	
14:43:00	179	07	Infinity	3376	5228	200	4984	German	Better Lit Zoom (x 3)	
14:45:00	179	08	Video	3376	5228	200	4984	German	Fly Through Start	
15:22:00-15:28:00	179	09	SUPR#1	3374	5224	217	4983	Huber	Whole Water (Tmax73°C, pumping @ ~16°C)	
15:28:00-15:48:00	179	10	SUPR#2	3374	5224	217	4983	Huber	Sterivex (Stable at 57°C)	
15:49:00-15:55:00	179	11	SUPR#3	3374	5224	217	4983	Huber	Whole water (pumping @ ~20°C)	
16:25:00	179	12	IGT-7	3375	5227	190	4983	Seewald	Tmax 101°C	
16:41:00	179	13	IGT-8	3371	5227	174	4983	Seewald	Tmax 101°C	

Nereus Dive #:- N-062

OASES 2013

Name of Site: Piccard

Sheet #:- 1 2

16:56:00	179	14	Temp	3370	5219	148	4980	German	Tmx 24.5°C	
16:56:00	179	15	Temp	3370	5219	148	4980	German	Tmax 8.8°C	
17:05:00	179	16	Temp	3372	5220		4979	German	Tmax 18.2°C	
17:09:00	179	17	Temp	3371	5219	158	4979	German	Tmax 8.3°C	
17:13:00	179	18	Temp	3372	5218	172	4978	German	Tmax 26.5°C	
17:45-18:05	179	19	SUPR#4	3361	5175	090	4960	Huber	Stervivex #4 (Tmax = 32.5°C)	
18:05-18:11	179	20	SUPR#5	3361	5175	090	4960	Huber	Whole Water #5 (Tmax = 31°C)	
18:11-18:14	179	21	SUPR#6	3361	5175	090	4960	Huber	Sterivex #6 (Tmax = 34°C)	
18:15-18:17	179	22	SUPR#7	3361	5175	090	4960	Huber	Whole Water #7 (Tmax = 32.5°C)	
18:14-18:17	179	23	Video	3361	5175	091	4960	German	HDTV Anemones	
18:20-18:21	179	24	Slurp	3361	5175	091	4960	Van Dover	10 Fat Shrimp	
18:23:00	179	25	Video	3361	5175	091	4960	German	Shrimp Valley Fly-Through	
18:27-18:32	179	26	Video	3361	5175	N/A	4958-4858	Phillips	Vertical Transect above Shrimp Valley	

Nereus Dive #:- N- 063 OASES 2013 Name of Site: Piccard

Sheet #:- 1 2

Time (UTC)	Jday	Sample No	Sample Type	Local X	Local Y	Hdg (Deg)	Depth (m)	Lead PI	Comments/Decription	
11:50:00	180	01	Micro	3362	5214	262	4980	Huber	2 pieces: Furry Walls rock	
11:57:00	180	02	Video	3362	5212	285	4980	German	Furry Walls (Wide)	
12:03:00	180	03	Video	3362	5212	285	4980	German	Furry Walls (Zoom)	
12:09:00	180	04	Video	3339	5203	212	5020	German	Sparse Shrimp	
12:15:00	180	05	Video	3340	5180	187	5179	German	Anemone Field	
12:30:00	180	06	Video	3342	5155	155	5155	German	Beebe Vent 4 (Wide)	
12:36:00	180	07	Video	3342	5155	155	5155	German	Beebe Vent 4 (Zoom @ Beehives)	
12:41:00	180	08	Video	3342	5155	155	5155	German	Beebe Vent 4 (Zoom at Orifice)	
12:51:00	180	09	Temp	3342	5155	155	4957	German	Tmax = 380°C, Beebe Vent 4	
13:04:00	180	10	SUPR 01	3342	5155	154	4957	Breier	Port 1 = Background	
13:19:00	180	11	SUPR 02	3342	5154	144	4957	Breier	Just above orifice	
13:23:00	180	12	SUPR 03	3342	5154	144	4957	Breier	Straight in front of basket	
13:26:00	180	13	SUPR 04	3342	5154	144	4957	Breier	High Up (Statue of Liberty)	

Nereus Dive #:- N- 063

OASES 2013

Name of Site: Piccard

Sheet #:- 1 2

13:29:00	180	14	SUPR 05	3342	5154	144	4957	Breier	Up to the Max at BV4	
13:34:00	180	15	SUPR 01	3342	5154	144	4957	Breier	Replaced Later	
13:40:00	180	16	SUPR 06	3343	5155		4956-4935	Breier	Buoyant Plume, Off Bottom	
13:42:00	180	17	SUPR 07	3343	5155		4932-4924	Breier	Buoyant Plume, Off Bottom	
13:44:00	180	18	SUPR 08	3343	5155		4923-4919	Breier	Buoyant Plume, Off Bottom	
13:47:00	180	19	SUPR 09	3343	5155		4917-4913	Breier	Buoyant Plume, Off Bottom	
13:49:00	180	20	SUPR 10	3343	5155		4910	Breier	Buoyant Plume, Off Bottom	
13:53:00	180	21	SUPR 11	3343	5155		4908	Breier	Buoyant Plume, Off Bottom	
13:56:00	180	22	SUPR 12	3342	5160		4905	Breier	Buoyant Plume, Off Bottom	
13:59:00	180	23	SUPR 13	3342	5161		4900	Breier	Buoyant Plume, Off Bottom	
14:05:00	180	24	SUPR 14	3343	5160		4885	Breier	100m up above seafloor	
16:23:00	180	25	IGT-4	3381	5153	132	4937	Seewald	Tmax = 78°C	
16:52:00	180	26	IGT-6	3382	5153	137	4937	Seewald	Tmax = 80°C, Sample = 42°C	