Scientific Prospectus for R/V Atlantis + ROV Jason Expedition AT42-12

Slow Life in the Fast Lane: Microbial Activity in the Crustal Deep Biosphere

Expedition dates and Ports: 15 May 2019 to 28 May 2019, Newport, OR, to Newport, OR (mobilization: 11-14 May 2019, demobilization: 29 May 2019)

Chief Scientist:
Beth N. Orcutt, Bigelow Laboratory for Ocean Sciences,
borcutt@bigelow.org, +01 (207) 315-2567, ext. 312

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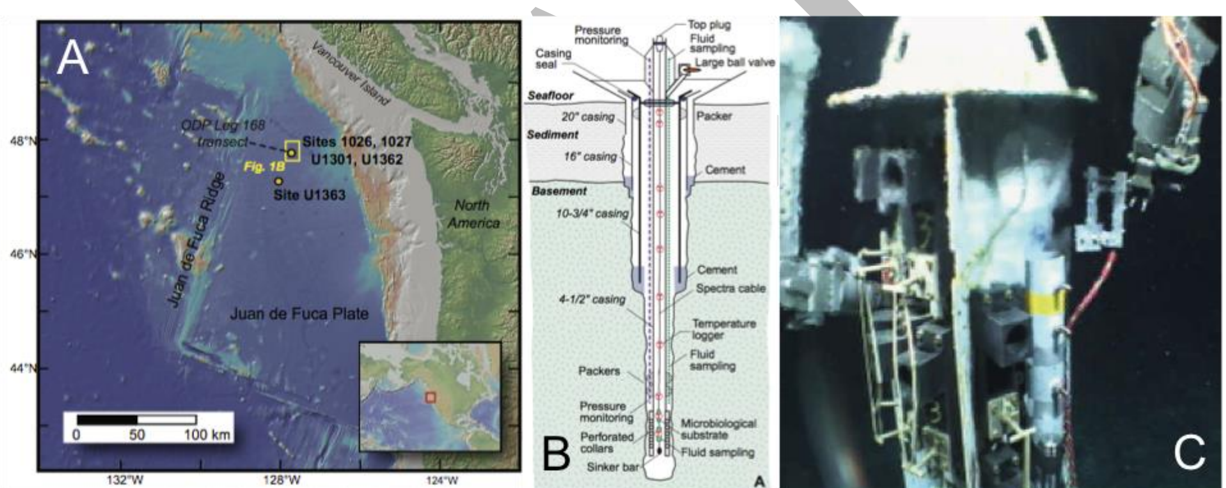
OCE-1851582 and linked awards – Co-PIs Stephanie Carr, Olivia Nigro, and Mike Rappé
OIA-1826734 and linked awards – Co-PIs Duane Moser, Beth Orcutt, Ramunas Stepanauskas, and Kai Ziervogel.



1. Expedition Overview

This expedition is supported through one primary U.S. National Science Foundation award (OCE-1737017, "Microbial activity in the crustal deep biosphere") to the Chief Scientist. In addition, complimentary research is being funded by one complimentary NSF award (OIA-1826734) to the Chief Scientist and three other investigators at the Chief Scientist's institution (Bigelow Laboratory for Ocean Sciences, East Boothbay, ME, USA); companion (pending) awards to collaborators at the University of Hawaii (Michael Rappé, OCE-1851582), Hawaii Pacific University (Olivia Nigro, OCE-1851045), and Hartwick College (Stephanie Carr, OCE-1851099); and a (pending) NASA award to the Chief Scientist (18-EXO18-0048). These awards support multidisciplinary sampling and experiments at subseafloor borehole observatories in oceanic crust on the eastern flank of the Juan de Fuca Ridge to assess microbiological processes in the deep biosphere. These experiments are intended to answer questions about how microscopic life survives under energy limitation in this subsurface habitat, to determine rates of biomass production and chemical cycling, to assess the interactions of viruses with hosts, and to conduct guided cultivation efforts.

This research builds upon over two decades of research at this location, started with the international Ocean Drilling Program (ODP): ODP Expedition 168 (1996), Atlantis cruise AT03-08 (1997), Atlantis cruise AT03-23 (1998), Atlantis cruise AT03-39 (1999), Atlantis cruise AT03-55 (2000), IODP Expedition 201 (2004), Thomas Thompson cruise TN-172 (2004), Atlantis cruise AT11-32 (2005), Atlantis cruise AT15-10 (2006), Atlantis cruise AT15-23 (2007), Atlantis cruise AT15-35 (2008), Atlantis cruise AT15-51 (2009), Atlantis cruise AT15-66 (2010), IODP Expedition 327 (2010), Atlantis cruise AT18-07 (2011), Atlantis cruise AT26-03 (2013), and Atlantis cruise AT26-18 (2014). This research also builds on investment of the Center for Dark Energy Biosphere Investigations (C-DEBI) NSF-funded science and technology center (OIA-0939564).

The primary work area is on the eastern flank of the Juan de Fuca Ridge (Table 1, Figure 1). Six long-term borehole observatories (CORKs) in a 2.5 square kilometer area are separated by distances of 40 to 2460 m, five aligned along a northeast trend (Holes 1026B, U1301A, U1301B, U1362A, and U1362B) and one located 2.2 km to the east (Hole 1027C; Figures 2, 3). All of these holes were drilled, cased, cored, and tested, then instrumented with CORKs using the drillship JOIDES Resolution. These instrumented sites allow continuous monitoring of pressure and temperature at depth, sampling of fluids and microbiological material, and measurement of fluid flow rate using autonomous instrumentation (Figure 4). Most of these CORK systems require servicing with a submersible or ROV to download pressure data, recover samples, manipulate valves, and replace a variety of experimental systems (Figure 4). This is the primary operational goal of this scientific research, which will use the ROV Jason from the R/V Atlantis (operated by the Woods Hole Oceanographic Institution, Table 2).

Secondary objectives may include (if time permits, Table 1): servicing additional CORK systems located nearby the main work site, and/or mapping/sampling at nearby Baby Bare, Grizzly Bare, Mama Bare, Wuzza Bare, or Zona Bare outcrops (within 50 nmi of primary work site).

Samples collected will be described and inventoried in a cruise report. The cruise report will be made publicly available through the Biological and Chemical Oceanography Database Management Office (BCO-DMO) project portal that has been established for the primary award (https://www.bco-dmo.org/project/700324, Project Coordinator: Beth Orcutt). Jason dive logs and frame grab imagery will be publicly available through the online “Jason Virtual Van” (http://4dgeo.whoi.edu/jason/). Video and still imagery will be described in the cruise report and made available to interested parties upon request. Any newly acquired geophysical data will be submitted to and made available, after the standard two-year proprietary hold, through the open-web accessible Marine Geoscience Data System (MGDS, www.marine-geo.org). Submission will include documentation of cruise operations and sampling information. Fluid geochemistry and microbiology data will be made available through publication and through the BCO-DMO portal referenced above. Follow-up on analyses will be published in a timely manner in internationally recognized, peer-reviewed journals.

Specifically, we aim to accomplish the following objectives (Table 2), in order of priority:

- Deploy custom incubation devices on the top of the Hole U1362B CORK to examine microbial growth rates and active community members in situ.
- Collect small volume (~200ml each) crustal fluid samples from the tops of Holes U1362A and U1362B CORKs with custom “squeezer” syringes to examine fluid chemistry and microbial diversity.
- Collect large volume (10s of liters) crustal fluid samples (and filters after in situ filtration) from multiple depth horizons of Holes U1362A and U1362S CORK through use of the mobile pumping system (MPS) coupled to Medium Volume Bag Samplers (MVBS) and Large Volume Bag Samplers (LVBS) for microbial cultivation, various ‘omics analyses, and viral analysis.
- Filter large volumes of crustal fluids from Holes U1362A/B for viral particle concentration through standalone filtration units deployed on the CORK wellheads and tapping into discrete horizons via umbilicals.
- Recover and deploy “OsmoSamplers” on the Hole U1362A/B wellheads for temporal tracking of chemical conditions in subsurface crust.
- Attempt to quantify in situ gas (methane) concentrations with in situ sensors and gas-tight fluid collection.
- Download pressure data from Holes U1362A/B.
- Leave Holes U1301A, U1362A, and U1362B sealed with top plugs.
- Measure temperatures of crustal fluids.
- Deploy a flow meter on Hole U1362A.
- Conduct full ocean depth CTD Niskin Rosette casts to examine microbial activity and diversity in the dark ocean water column.
- If time permits (unlikely), conduct exploratory dives at nearby outcrops to find sites of diffuse venting for sampling and characterization.
- If weather or mechanical issues arise that preclude ROV dives, we will collect multi-beam bathymetric data.

In addition to the primary scientific and technical goals, we will include a modest education, outreach, and communications (EOC) program, although we will not have sufficient bandwidth for streaming ROV dive footage. This effort is being developed and will be promoted through the C-DEBI network.

2. Operational Needs/Plans

This project will be executed from the RV Atlantis platform. The bulk of the science plan revolves around use of the ROV Jason, with full ocean depth CTD Niskin rosette casts during ROV down time. ROV Jason will be operating with its own launch and recovery system (LARS) in “single body” mode with the science tool skid. In the event of weather or mechanical issues that prevent water column or ROV work at the primary or secondary sites, we will fill time with multibeam mapping in the area. We intend to have both walk-in temperature-controlled rooms on Atlantis set to 4ºC for the duration of the cruise (science party members can see the link below under logistics for Atlantis to learn more about layout and capacities).

The following is a list of unique materials and equipment that are needed to accomplish our scientific goals. Details about instruments are provided in Table 3.

- Jason: Electrical connections
  - ODI for pressure data download (as used on AT39-01 dives, Figure 5)
  - Mobile Pumping System Controller (as used on AT39-01 dives, Figure 6)
  - Mobile Pumping System Oxygen Optode (as used on AT39-01 dives, Figure 6)
  - Medium Volume Bag Sampler McClane valving system (as used on AT39-01 dives, Figure 7)
  - Franatech METS methane sensor connected to Jason’s SBE19 seabird system (as used on AT42-01 dives, Figure 8)
  - Jason temperature probe (the maximum temperature of venting should be 65ºC)
- Jason: other third-party non-connected instruments to deploy/recover
  - CORK top plugs (Figure 9)
  - Running and pulling tools for top plugs (Figure 10)
  - Nut drivers for turning dogs on CORK to release/secure top plugs
  - Incubation modules and insert (details to be determined, being designed and built by Orcutt; essentially PVC tubing and junctions with syringes mounted inside, to be stuck into the top of the CORK, PENDING Figure 11)
  - Squeezer syringes (Figure 12)
  - Virus filtration unit (Figure 13)
  - OsmoSamplers (Figure 14)
  - Flow meter (Figure 15)
  - Gas tight samplers (PENDING Figure 16)
  - Push cores (not third party, would use Jason’s inventory; Figure 17)
- WHOI/Jason Elevator with release, weights, homer/tracking probe: we intend to deploy/recover elevators for each dive (Figure 18).

3. Draft Dive Plans

The operational plan estimates 3 days for transit + 11 days on site (10 operational days for Orcutt + 1 operational day for Jason engineering dive). The following dive plan is designed to accomplish the major operational objectives of the expedition PI group, but does not leave much space for contingency, so this must be kept in mind. And as with any cruise, these plans are only *plans*, and we will have to be responsive to conditions at sea. Conservative estimates for bottom time and Jason turn-around time activities were used.

The Chief Scientist will lead daily meetings to cover the dive progress and plan next operations in consultation with the Expedition Leader form the Jason group. Jason "watch" schedules will be developed by the Chief Scientist prior to the cruise, where each science party member will have a regular 4-hour-per-day shift in the Jason control van to assist with dive direction and logging operations. Training for these efforts will occur either during mobilization or during the first day of transit. In addition to logging events and information relevant to the primary dive operations, dive logs will also record any deep-sea animal sightings (and video/photos will also be captured and logged), for aiding global deep-sea biology inventory efforts. A "cheat sheet" of animal types will be available to help with this task.

During ROV turnaround time, we may conduct full-ocean depth CTD Niskin rosette sampler casts targeting water column depths below the thermocline. The timing of these casts will be communicated with the ship's crew well ahead of time for scheduling purposes.

In the dive plans below, changing configurations for the Jason "basket" and swingarms, and for the WHOI elevator, are indicated for each dive**. We plan to have the Medium Volume Bag Sampler (MVBS) and associated McClane pump loaded in the back of Jason (as done on AT39-01; Figure 4), and a Franatech methane sensor mounted on the Jason frame (as done on AT42-01), on all dives.** See Table 3 for more information about instrument weights and electronic needs.

Dive 1 – Dive tasks

Est. Time (h)	Objectives
21.5	**Hole U1362B**
3	deploy elevator, deploy Jason
0.25	360 documentation
0.25	Osmo bay - T-probe measurements in outflow, close valves
0.25	Pressure bay - turn valves for Hydrostatic check (*wait at least 30 min b4 turning valves again!*)
0.5	Osmo bay - remove Yellow OsmoSampler (double wide from AD4758)
0.25	Pressure bay - turn valves back to formation (*wait at least 30 min b4 downloading*)
0.5	elevator - stow Yellow Osmosampler
2	elevator - practice manipulating incubation chimney + modules
1	elevator - trigger chimney modules to collect bottom seawater samples
1	elevator - stow incubation chimney + modules, pick up virus filtration unit, release elevator
2	recover elevator
1	Pressure bay - pressure download
5	MBIO bay - MPS collect water from U1362B bioline into MVBS + LVBS
1	MBIO bay - deploy virus filtration rig on U1362B bioline
0.5	test methane sensor
0.5	away from CORK - test fire squeezer samplers for bottom water collection
2.5	recover Jason
12	***Jason turnaround time/CTD cast***

Dive 1 – Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: ODI for pressure downloac	deploy: incubation chimney + modules
LVBS	P: methane sensor wand	deploy: virus filtration unit
toilet brush	S: squeezer samples	recover: incubation chimney + modules
T-probe		recover: Yellow OsmoSampler
dive weights		

Dive 2 – Dive tasks

Est. Time (h)	Objectives
23	**Hole U1362B**
3	deploy elevator, deploy Jason
0.5	MBIO bay - recover virus filtration rig
1	elevator - stow virus filtration rig in elevator
5	MBIO bay - MPS collect water from U1362B bioline into MVBS + LVBS
0.5	top plug - loosen dogs, remove weight stack
1	top plug - engage pulling tool and remove top plug
1	top plug - T-probe in flowing fluids, fire some squeezer samplers
0.5	top plug - test methane sensor
1	elevator - stow top plug + pulling tool
1	elevator - pick up incubation chimney + modules
1	top plug - deploy incubation chimney + modules
1	top plug - T-probe outflow from chimney, fire remaining squeezer samplers
1	top plug - trigger incubation devices
1	top plug - remove T-zero incubation module to basket
1	elevator - stow incubation module on elevator
0.5	elevator - release elevator
2	recover elevator
1	recover Jason
12	***Jason turnaround time/CTD cast***

Dive 2 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: dive weights	deploy: Incubation chimney pieces
LVBS	P: methane sensor wand	recover: virus filtration unit (recovery)
wrench for top plug	S: squeezer samplers	recover: top plug + pulling tool
RS pulling tool (*deploy only, recovered on elevator*)		recover: incubation module
toilet brush		
T-probe		
dive weights		

Dive 3 – Dive tasks

Est. Time (h)	Objectives
22.25	**Hole U1362A**
3	deploy elevator, deploy Jason
0.25	Osmo bay - T-probe measurements in outflow, close valves
0.25	Pressure bay - turn valves for Hydrostatic check (*wait at least 30 min b4 turning valves again!*)
0.25	360 documentation
0.25	Osmo bay - remove Black OsmoSampler (double wide from AD4759)
0.25	Pressure bay - turn valves back to formation (*wait at least 30 min b4 downloading*)
0.25	elevator - stow Black OsmoSampler
0.25	elevator - sqeezers and gas tights
0.25	**Hole U1362B**
1	top plug - T-probe outflow from chimney, fire squeezers and gas tights
0.5	top plug - test methane sensor
0.5	elevator - stow squeezers and gas tights
0.5	elevator - pick up GS running tool + top plug
0.25	**Hole U1301A**
0.25	360 documentation
1	top plug - insert top plug + disengage running tool
1	elevator - stow running tool + release elevator
2	recover elevator
0.5	top plug - engage dogs
0.5	top plug - place weight stack
0.25	**Hole U1362A**
1	Pressure bay - pressure download
5	MBIO bay - MPS collect water from U1362A deep bioline into MVBS + LVBS
1	MBIO bay - deploy virus filtration rig on U136A deep bioline
2	recover Jason

Dive 3 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: ODI for pressure downloac	deploy: GS running tool + top plug
LVBS	P: methane sensor wand	deploy: squeezers
cradle on top of LVBS	S: virus filtration rig	deploy: gas tights
) wrench for top plug		recover: squeezers
toilet brush		recover: gas tights
T-probe		recover: GS running tool
dive weights		recover: OsmoSampler

Dive 4 – Dive tasks

Est. Time (h)	Objectives
22.75	**Hole U1362A**
3	deploy elevator, deploy Jason
3	MBIO bay: MPS U1362A shallow MVBS only
1	MBIO bay: recover virus filtration rig on U1362A deep bioline
0.5	top plug - loosen dogs, remove weight stack
1	elevator - stow virus filtration rig + retrieve running tool
1	top plug - engage pulling tool and remove top plug
1	elevator - stow pulling tool and top plug
1	top plug - deploy flow meter for at least 2 hours
1	top plug - T-probe in flowing fluids, fire half of squeezer samplers
0.5	top plug - test methane sensor
1	top plug - remove flow meter and stow on basket
1	elevator - pick up OsmoSampler
0.25	**Hole U1362B**
1	Osmo bay - deploy OsmoSampler
1	top plug - T-probe in flowing fluids, fire half squeezer samplers
0.5	top plug - test methane sensor
1	top plug - remove T-1 incubation module to basket
1	elevator - stow T-1 incubation module and release elevator
2	recover elevator
1	recover Jason
12	***Jason turnaround time/CTD cast***

Dive 4 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: methane sensor wand	deploy: RS pulling tool
flow meter	S: squeezer samplers	deploy: OsmoSampler
wrench for top plug		recover: RS pulling tool + top plug
toilet brush		recover: T-1 incubation module
T-probe		recover: virus filtration rig
dive weights		

Dive 5 – Dive tasks

Est. Time (h)	Objectives
22	**Hole U1362A**
	note: may remove LVBS if 2nd flow meter deployment needed
3	deploy elevator, deploy Jason
0.5	elevator - pick up OsmoSampler
1	Osmo bay - deploy OsmoSampler, T-probe outflow
1	top plug - T-probe in flowing fluids, fire squeezer samplers, use methane sensor
0.5	elevator - pick up gas tights
1	top plug - fire gas tights
1	elevator - stow gas-tights, recover top plug + running tool
1	top plug - insert top plug and disengage running tool
1	elevator - stow running tool, remove weight stack
0.5	top plug - deploy weight stack
0.5	elevator - pick up virus filtration rig + release elevator
2	recover elevator
6	MBIO bay - MPS collect water from U1362A deep bioline into MVBS + LVBS
1	MBIO bay - deploy virus filtration rig on U1362A deep bioline
2	recover Jason
12	***Jason turnaround time/CTD cast***

Dive 5 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: ODI for pressure downloac	deploy: OsmoSampler
LVBS	P: methane sensor wand	deploy: top plug with GS running tool
cradle on top of LVBS	S: squeezers	deploy: virus filtration unit
wrench for top plug		deploy: weight stack
toilet brush		deploy: gas tights
T-probe		recover: GS running tool
dive weights		recover: gas tights

Dive 6 – Dive tasks

Est. Time (h)	Objectives
21.25	**Hole U1362B**
	note: may remove LVBS if flow meter deployment needed
3	deploy elevator, deploy Jason
1	top plug - T-probe in flowing fluids, fire squeezer samplers
1	top plug - remove T-final incubation module
1	elevator - stow incubation module
1	top plug - remove incubation chimney
1	elevator - stow incubation chimney
1	elevator - recover top plug + running tool
1	top plug - insert top plug and disengage running tool
1	elevator - stow running tool, remove weight stack, release elevator
2	recover elevator
0.5	top plug - deploy weight stack
5	MBIO bay - MPS collect water from U1362B bioline into MVBS + LVBS
0.5	Pressure bay - pressure download
0.25	360 documentation
2	recover Jason
12	***Jason turnaround time/CTD cast***

Dive 6 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: ODI for pressure downloac	deploy: GS running tool + top plug
LVBS	P: methane sensor wand	recover: GS running tool
wrench for top plug	S: squeezers	recover: T-final incubation module
toilet brush		recover: incubation chimney
T-probe		
dive weights		

Dive 7 – Dive tasks

Est. Time (h)	Objectives
12.75	**Hole U1362A**
2	deploy Jason
1	MBIO bay - recover virus filtration rig from U1362A deep bioline + stow in swingarm
5	MBIO bay - MPS collect water from U1362A shallow into MVBS + LVBS
0.5	Pressure bay - pressure download
0.25	360 documentation
2	sediment push coring near Hole U1301A
2	recover Jason
12	*Jason turnaround time/CTD cast*

Dive 7 - Basket, Swingarm and Elevator needs

Basket needs	Swingarm needs	Elevator needs
Mobile Pumping System	P: ODI for pressure downloads	
LVBS	P: methane sensor wand	
sediment push core milk crate	S: virus filtration rig	
toilet brush		
T-probe		
dive weights		

4. Staffing, Logistics, Planning, and Safety

4.1. Staffing

We anticipate sailing 21 scientific staff (including an outreach specialist), in addition to the regular WHOI technical and ROV Jason support teams. The current science staffing list is summarized in Table 4.

All science party members MUST complete a Shipboard Scientific Personnel Form (link below) by April 15, 2019. This form collects information about your citizenship, passport information, medical history, participating sponsor, insurance requirement, and food or dietary restrictions. The name on the personnel form must match the name on your passport. Any scientific participants that are not at UNOLS (https://www.unols.org/) participating organizations also need to fill out the Scientific Personnel Waiver of Liability, Indemnity and Consent Agreement form on page 2 of the form. This might take time, so don't wait until the last minute! Please ask the Chief Scientist if you need to help to determine if your institution is a part of UNOLS.
https://www.whoi.edu/fileserver.do?id=19605&pt=2&p=19610

4.2. Logistics and Planning

General information on WHOI Cruise Planning can be found here, including "Tips for Going to Sea":
http://www.whoi.edu/main/cruise-planning

Information on the R/V *Atlantis* is available here:
http://www.whoi.edu/main/ships/atlantis

Information on the ROV *Jason II* is available here:
https://ndsf.whoi.edu/jason/

Cruise synopsis:
http://www.whoi.edu/page.do?pid=8316

Our mobilization and demobilization activities will occur in Newport, Oregon. As our transit time to the site is limited (~24 hours), trainings will likely take place during mobilization operations, so all science party members are asked to arrive in Newport no later than noon on 13 May, 2019, to be available for training.

Transportation Worker Identification Credential (TWIC) cards are required ID at every US port and terminal. If you do not have a TWIC, you must be escorted inside the port facility by a member of the science party or crew who has a TWIC. Depending on the port terminal, 1 TWIC card holder can normally escort up to 5 non-TWIC card holders. Please notify the Chief Scientist if you have a TWIC card. US citizens can apply for a TWIC card at https://www.tsa.gov/for-industry/twic

Science party members are expected to move on board the ship by noon on the day before departure, and to move out of cabins and remove equipment from the ship by noon on the day after the cruise completion. The science party is responsible for their own meals during a port call before moving into their cabin.

4.2.1. Shipping

Science party members are responsible for shipping their gear to and from the ship, and for loading and unloading science gear from the ship. Ship's crew will generally help with slinging consolidated loads of gear to/from the dock and the deck, but do not expect them to carry your gear around on the ship or on the dock. Shipments should arrive at least 5 days before the day of loading to minimize risk.

Information for the agent will be supplied at a future date.

It is highly advisable to notify the shipping agent, chief scientist, and Marine Operations Coordinator (Sarah Fuller, sfuller@whoi.edu) of any special shipment needs. In particular, please NOTE that shipping hazardous materials/chemicals is a difficult business and cannot be done flippantly. See guidance at the bottom of this page: http://www.whoi.edu/page.do?pid=8500.

Shipments arranged through the agent are chargeable to the science party members incurring them, as are any costs incurred for storing equipment prior to or after the cruise. Financial arrangements should be made in advance with the Marine Operations Coordinator (Kerry Strom).

Before the end of the cruise, the Chief Scientist will make a coordinated request to the agent to arrange for any dry ice needed for shipping samples at the end of the cruise. Please note that limited quantities of liquid nitrogen are available on the ship for charging "dry shippers."

4.3. Safety

4.3.1. Required forms

This is a set of information and forms (some of which are discussed below) that all expedition participants should review and complete (as needed):
http://www.whoi.edu/page.do?pid=12795

WHOI Safety Guidelines and UNOLS RVOC Safety Training Manual MUST be read and understood by all members of the science party:
http://www.whoi.edu/page.do?pid=8320
https://www.unols.org/sites/default/files/RVOC_Safety_Manual_Chap_1_Scanned_lo_res.pdf)

It is also a good idea to read the UNOLS Research Vessel Safety Standards to get an in-depth look at safety aboard a working research vessel platform:

https://www.unols.org/sites/default/files/RVSS_10_Most_Current_Master_Copy_Jan_2019_2.pdf

4.3.2. Hazardous Materials

Anyone bringing hazardous materials must read this page and associated links: http://www.whoi.edu/page.do?pid=8336#0

The Chief Scientist will compile a list of all chemicals and Hazardous Materials to be used on the cruise. Science party members are responsible for bringing Safety Data Sheets (SDS) for ALL chemicals brought on board and have plans for collecting all chemical wastes. The science party must supply spill kits for large amounts and unique Hazardous Materials. Science party members must bring appropriate personal protective equipment for safely handling the chemicals (i.e. gloves, safety glasses, lab coats). ALL chemicals and wastes must be removed from the ship by the science party members at the end of the cruise.

NOTE: Radioactive Materials are not to be used on this cruise!

4.3.3. Required safety materials for working on the ship

All members of the AT42-02 shipboard party must bring closed toed and closed backed shoes on board the vessel. Open toed and open backed shoes are only allowed in cabins. Crocks, sandals, and similar types of shoes are NOT considered closed toed and are NOT allowed on deck or in the lab. Sneakers, boots, hiking and similar shoes are considered closed toed and allowed on deck and in the lab. Steel-toed shoes are recommended when working on deck. If you will be deploying instruments over the side, like moorings or large deployments, steel-toed shoes are required.

Hard hats are required for work on the back deck when working with overhead loads (like CTD casts, Jason deployments, elevator deployments, etc.). If you do not have your own hard hat, you can borrow one of the general use ones in the main lab. Work vests/life jackets must be worn for any operations where equipment is being deployed over the side and any deck work at night. These can be borrowed from the common pool in the main lab.

4.3.4. Shipboard Safety and Conduct

Smooth operation of the science program requires continuous communication between science and ship personnel. Keep the bridge and chief scientist informed of your intentions at all times. You can call the bridge from any shipboard phone. Never put any gear over the side without consulting with the bridge first.

The science party is responsible for securing all gear in laboratories and science areas. Straps and braces are available in the main lab to assist with securing, but science party members are encouraged to plan ahead for equipment security needs. Ask for assistance from one of the technicians or crew if there are questions about securing any equipment.

WHOI has established a firm policy that no alcoholic beverages of any type are permitted on the vessel. Members of the science party shall not bring on board alcoholic beverages. Likewise, the possession of use any controlled substance/drugs will not be tolerated. All persons on board are subject to drug and alcohol testing for reasonable cause in the event of a "serious marine incident." Smoking and vaping is prohibited within the ship's enclosed spaces.

Limited medical supplies are carried on every voyage and are administered by the Chief Mate or other person designated by the Master. In a medical emergency at sea, the Master retains the final responsibility and authority for treatments and actions taken. Individuals should supply all special medication which they require during a voyage. The Master should be informed if a member of the scientific party is on medication which may cause unusual behavior or precipitate an emergency.

WHOI and the Chief Scientist are committed to maintaining a positive working and learning environment free of illegal discrimination, harassment and intimidation. All science party members will be briefed at the beginning of the cruise of WHOI's personal conduct and harassment policies designed to promote an atmosphere of professionalism and mutual respect. Any violations to the harassment policy shall be reported to the Master, Chief Mate, or Chief Scientist.

Any science party members who are or expect to be pregnant or nursing during the cruise should make the Chief Scientist aware as soon as possible, so that we can begin discussions with WHOI's Port Captain to discuss needs and potential risks to determine how to best support the science party member.

Table 1. Primary and contingency dives sites for AT42-12. For more information about these locations, see Fisher et al. 2012, Wheat et al. 2013 G3, Hutnak et al. 2006 G3, Zühlsdorff et al. 2005 IODP 301 Proceedings. *Visited on Alvin Dive 4538 cruise AT15-51 in 2009.

Site Name	**Objective**	**Lat (N)**	**Lon (W)**	**Water depth (m)**
Primary dive sites				
Hole U1301A	Deploy top plug	47º 45.209’	127º 45.833	2658
Hole U1362A	Collect pristine crustal fluid samples, flow meter deployment, pressure downloads	47º 45.662	127º 45.674	2658
Hole U1362B	Collect pristine crustal fluid samples, incubation experiments, pressure downloads	47º 45.499	127º 45.733	2658
Contingency dive sites				
Baby Bare outcrop	Exploration dive for rock and fluid collecting	47º 42.630	127º 47.711	
Grizzly Bare outcrop	Exploration dive for rock and sediment collecting	47º 16.176	128º 47.297	~2700
Mama Bare outcrop	Exploration dive for rock and sediment collecting	47º 50.280	127º 45.838	~2650
Wuzza Bare subcrop	Exploration dive to look for evidence of seepage, sediment coring	47º 47.487	127º 47.788	~2680
Zona Bare outcrop*	Exploration dive to look for weeping vents, fluid sampling, rock collecting	48º 11.4	127º 33	~2500-2580

Table 2. Planned operational task overview for dives on AT42-12. BW: bottom water; n.a.: not applicable, - : not currently planned.

Site – Horizon	**U1362A-shallow**	**U1362A – deep**	**U1362B**	**U1301A**	**BW**
Pressure, Begin	3	3	1	n.a.	-
Pressure, End	7	7	6	n.a.	-
Top plug, remove	4	n.a.	2	n.a.	-
Top plug, deploy	5	n.a.	6	3	-
Flow meter	4	n.a.	-	n.a.	-
OsmoSampler, recover	n.a.	3	1	n.a.	-
OsmoSampler, deploy	-	5	4	n.a.	-
MVBS fluid sampling	4 (pre-open)	3 (pre-open), 5 (post)	1+2 (pre-open), 6 (post)	n.a.	-
LVBS fluid sampling	-	3 (pre-open), 5 (post)	1+2 (pre-open), 6 (post)	n.a.	-
Virus filtration, deploy	3 (pre-open)	-	1 (pre-open)	n.a.	-
Virus filtration, recover	4	-	2	n.a.	-
Squeezers	4, 5	n.a.	2, 3, 4, 6	n.a.	1
Incubation samples		n.a.	2, 4, 6	n.a.	1
Gas tights	5	n.a.	3	n.a.	-
Sediment push cores	7	n.a.	-	n.a.	-

Table 3. Overview of instruments/equipment planned for use on Jason on AT42-02, including in water weights, dimensions, comms and power needs, recent example Jason dives were these instruments were used, and lead PI responsible for the instrument/equipment. Green highlights instruments that require comms/power connection to Jason. Yellow highlights data to be determined.

Name	Weight in water (lb)	Dimensions	Comms	Power	Recent example dives	PI
Pressure, flow and CORK servicing						
GS running/pulling tool (Tools International)	24	12"L x 1.75" OD	n.a.	n.a.	J2-1031	Becker
RS pulling tool (Tools International 40RS1200 2")	5	13"L x 2" OD	n.a.	n.a.	J2-1033	Becker
top plug - U1301A	49	24"L x 4" OD	n.a.	n.a.	J2-1034	Becker/Wheat
top plug - U1362A/U1362B	50	24"L x 4" OD	n.a.	n.a.	J2-1034	(on seafloor)
CORK Pressure ODI connector (SeaCon AWM-8X-FS)	3.4	trivial	RS-422	?	J2-1024 thru 1029	Davis/Becker
nut drivers for loosening/tightening CORK dogs	5	trivial	n.a.	n.a.	J2-1024 thru 1029	Fisher
Flow meter	50	47"L x 6"W	n.a.	n.a.	J2-1031	Wheat
CORK Incubation experiments						
Incubation chimney base	TBD	TBD	n.a.	n.a.	n.a.	Orcutt
Incubation chimney modules	TBD	TBD	n.a.	n.a.	n.a.	Orcutt
Squeezer syringes	7	6"L x 5"W x 14"H	n.a.	n.a.	J2-1036	Wheat
OsmoSamplers to recover (doublewide with Standard, Gas, BOSS)	35	28"L x 14"W x 14"H	n.a.	n.a.	J2-1024 thru 1029	Wheat
OsmoSamplers to deploy (assume same)	35	28"L x 14"W x 14"H	n.a.	n.a.	J2-1024 thru 1029	Wheat
Mobile Pumping System and Associated						
Jannasch connector and tubing for MPS	4.5	12"L x 12"W x 6"H	n.a.	n.a.	J2-1024 thru 1028	Rappe
Mobile Pumping System (MPS): controller	32	20"L x 20"W x 24" H	TBD	TBD	J2-1024 thru 1028	Rappe
" MPS oxygen optode	-	-	TBD	TBD	J2-1024 thru 1028	Rappe
Medium Volume Bag Sampler with McClane unit (MVBS)	34	43"L x 24" W x 24"H + McClane	TBD	TBD	J2-1024 thru 1028	Rappe
Large Volume Bag Sampler (LVBS) with spigot assembly	6	32"L x 17"W x 12"H	n.a.	n.a.	J2-1024 thru 1028	Rappe
Virus filtration unit	TBD	TBD	n.a.	n.a.	J2-1028	Nigro
Other						
Sediment Push Cores	TBD	TBD	n.a.	n.a.	enumerable	(JASON)
gas tights	TBD	TBD	n.a.	n.a.	J2-1109	Nigro
Seabird pump for methane sensor (SEB19V2 Plus CTD)	TBD	TBD	RS232	9-28VDC	J2-1109	Orcutt
Methane sensor (Franatech METS, 4000m; connected to SBE19)	1	12"L x 2" OD	RS232	9-36VDC, 40	J2-1109	Orcutt

Table 4. Anticipated scientific staff for AT42-12 (as of January 9, 2019). *, tentative and to be confirmed. Green shading, primary OCE-1737017 group; blue shading, OIA-1826734 and associated awards group; Yellow shading, collaborators for CORK pressure/chemistry; Pink shading, complimentary OCE-1851582 and associated awards group.

No	Last Name	First Name	PI Group	Role	Email	Nat.	Gen.
1	Orcutt	Beth	Orcutt	Chief Sci.	borcutt@bigelow.org	USA	F
2	D'Angelo	Tim	Orcutt	Technician	tdangelo@bigelow.org	USA	M
3	Booker	Anne	Orcutt	Postdoc	booker.132@buckeyemail.osu.edu	USA	F
4	Van Den Berghe	Martin	Orcutt	Grad. Stu.	mdvanden@usc.edu	?	M
5*	TBD	TBD	Orcutt	TBD	TBD	?	?
6	Stepanauskas	Ramunas	MicroG2P	Co-PI	rstepanauskas@bigelow.org	?	M
7	Lindsay	Melody	MicroG2P	Postdoc	melody.lindsay@msu.montana.edu	USA	F
8	Moser	Duane	MicroG2P	Co-PI	Duane.Moser@dri.edu	USA	M
9*	TBD	TBD	MicroG2P	Postdoc	TBD	?	?
10	Ziervogel	Kai	MicroG2P	Co-PI	Kai.Ziervogel@unh.edu		M
11*	Becker	Keir	Becker	CORKs	kbecker@rsmas.miami.edu	USA	M
12	Fournier	Trevor	Wheat	Technician	tfournier@csumb.edu	USA	M
13	Price	Adam	Fisher	Grad. Stu.	adamprice@ucsc.edu	USA	M
14	Rappé^	Mike	Rappé	Co-PI	rappe@hawaii.edu	USA	M
15	Freel	Kelle	Rappé	Postdoc	kfreel@hawaii.edu	USA	F
16*	TBD	TBD	Rappé	TBD		?	?
17*	TBD	TBD	Rappé	TBD			
18	Nigro^	Olivia	Nigro	Co-PI	onigro@hpu.edu	USA	F
19	Spotkaeff	Cherisa	Nigro	Undergrad	csotkae@my.hpu.edu	USA	F
20	Carr	Stephanie	Carr	Co-PI	carrs@hartwick.edu	USA	F
21	Gourdine	Tylisha	Carr	Undergrad.	gourdinet@hartwick.edu	USA	F

^ - disclosure that these two science party members are members of immediate family with each other, all should be aware of WHOI policies on this: http://www.whoi.edu/cms/files/Guests_policy_22763.pdf.

Figure 1. Planned cruise track for AT42-12 to/from Newport, Oregon, which is roughly 250 nm or ~24 hours of transit in each direction assuming 10 kn transit speed. The primary work area is within Canadian territorial waters and requires clearance.

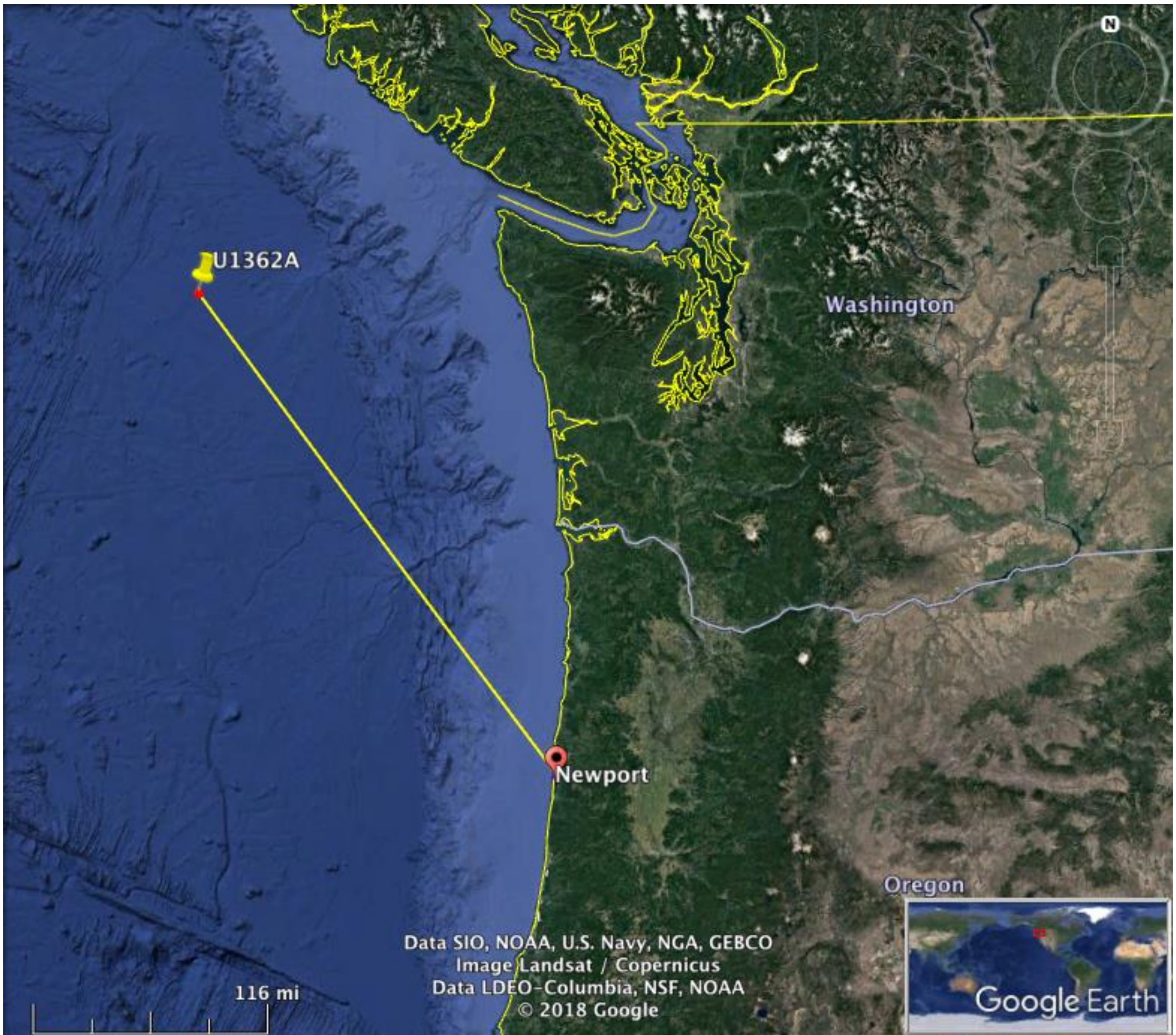


Figure 2. Regional bathymetric map of primary and secondary work sites, from Hutnak et al. 2006.

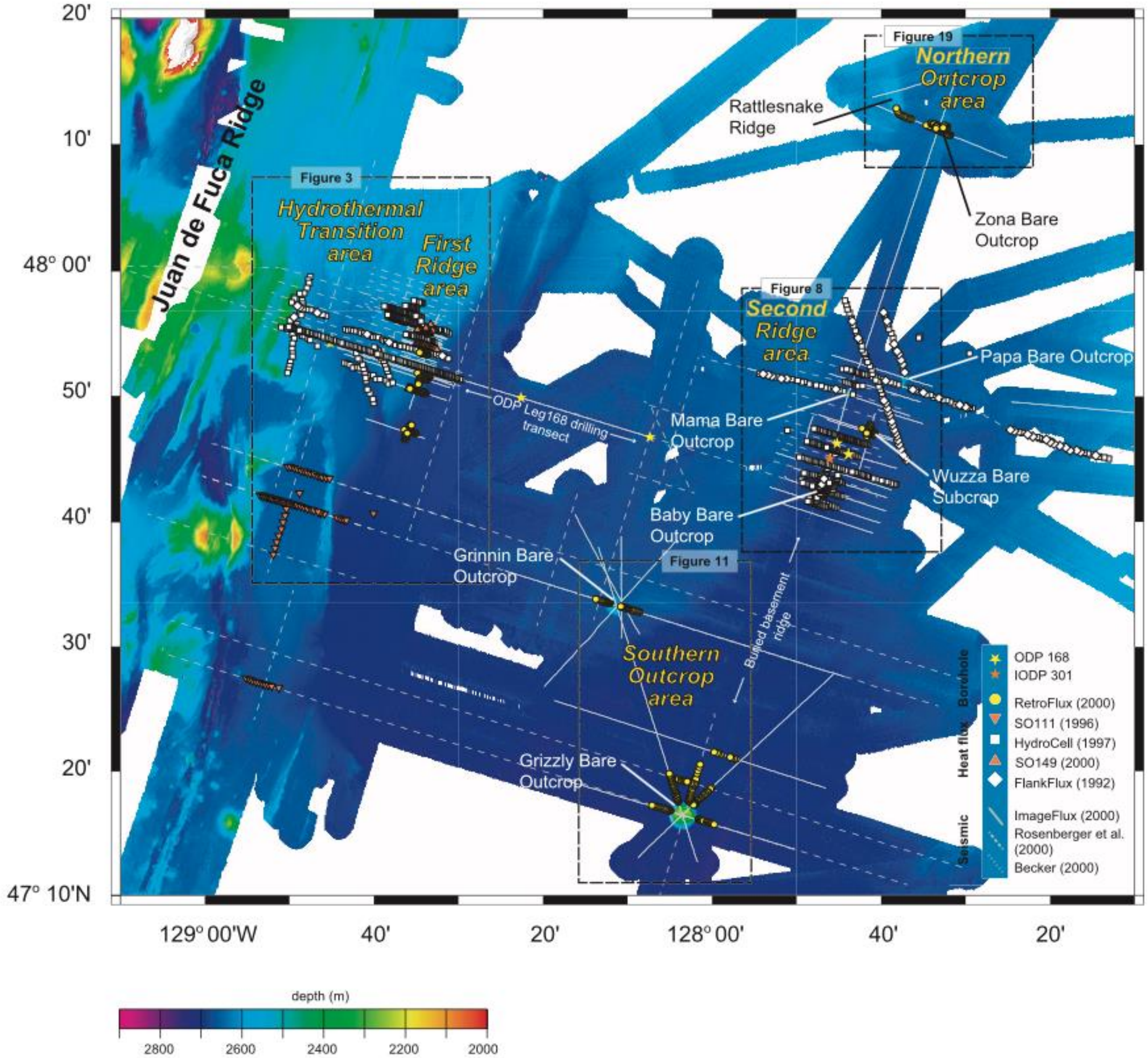


Figure 3. Detailed bathymetric map of primary work sites, from Andy Fisher.

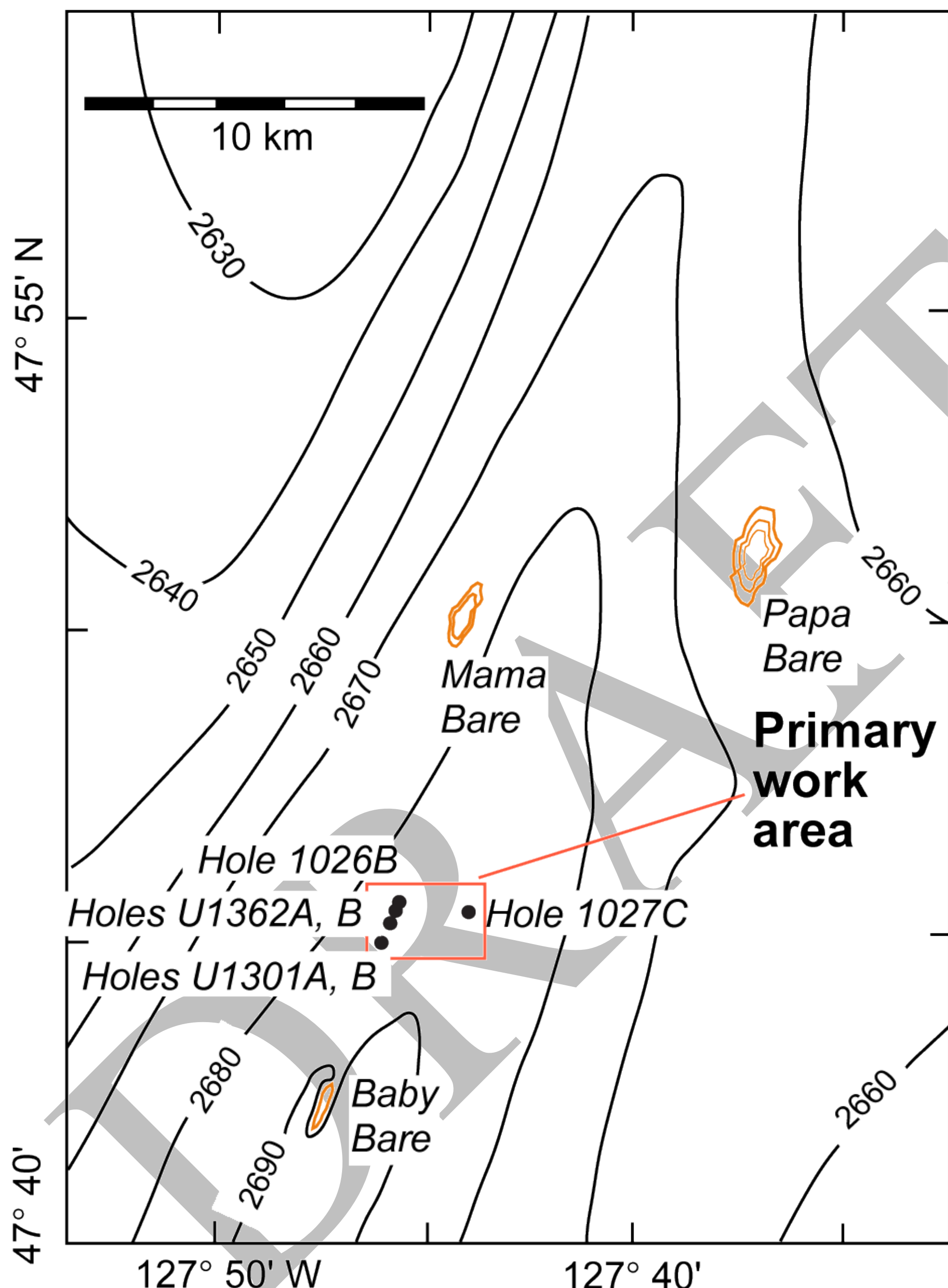


Figure 4. Top Left: Schematic of CORK installation, see Fisher et. 2012 for more details. Top Right: Photo of 64ºC shimmering water existing a Juan de Fuca CORK (from a lateral ball valve, not to be used on this cruise). Bottom: Photo of Jason loaded with fluid sampling equipment to be used on this cruise, as on AT39-01 (front: mobile pumping system and OsmoSampler; back: medium volume bag sampler)

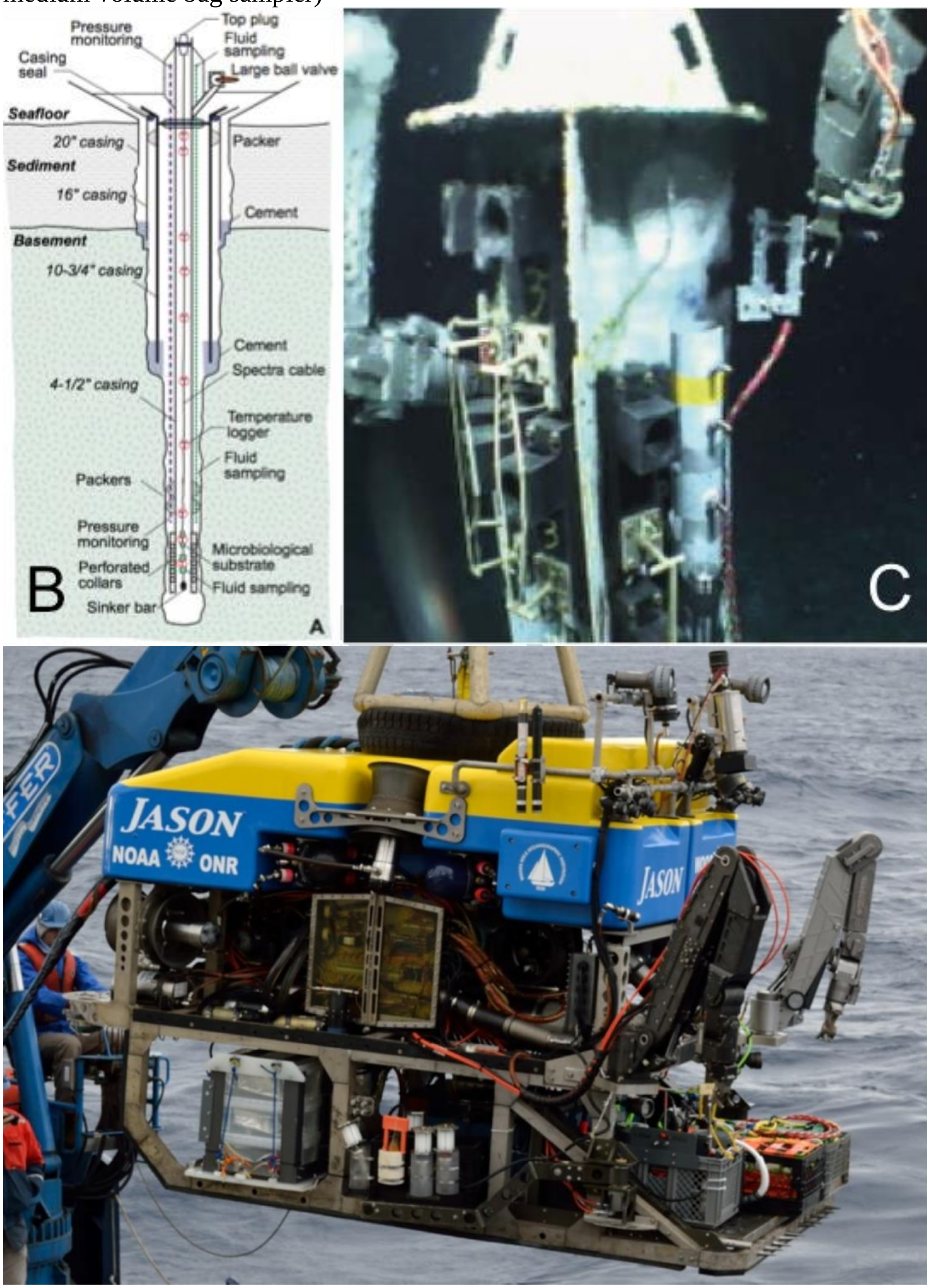
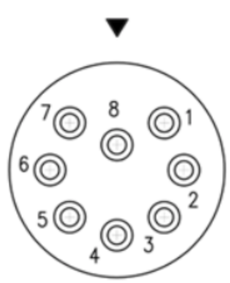


Figure 5. Information about ODI connector for pressure downloads. Also see recent configuration information from Jason dives J2-1024 – J2-1028.

CORK ODI RS-422, AWM-8X-FS PIGTAIL THROUGH ALVIN TO INSIDE DB-9

AWM	function	DB9-FS	aka
1	from CORK +	3	Rx+
2	from CORK -	4	Rx-
3	unused	5	gnd
4	power +	-	not needed
5	power -	5	gnd
6	to CORK +	2	Tx+
7	to CORK -	1	Tx-
8	shield	5	gnd

AWM-8X-FS CONTACTS, FACE VIEW (from SeaCon All-Wet catalog):



8x

Figure 6. Mobile Pumping System (MPS) Controller and Large Volume Bag Sampler (LVBS). Top: Example of MPS (right and center) and LVBS (right) mounted on the front of Jason on dive J2-1024. Bottom: Schematic illustrating the connection of the MPS controller to the Jason junction box and peripheral sampling devices. See dive J2-1024 – J2-1028 config files for more information.

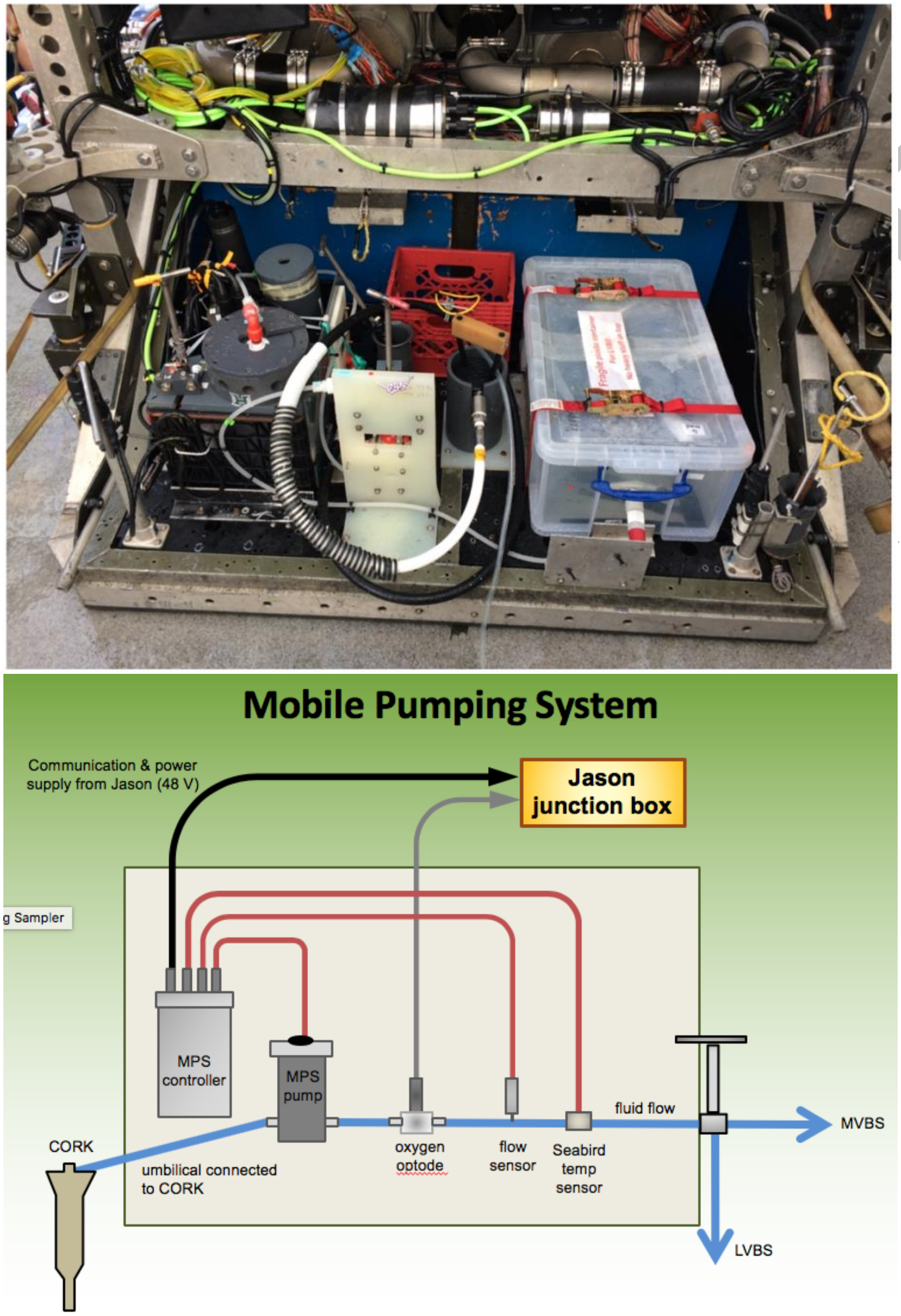


Figure 7. Medium Volume Bag Sampler (MVBS). Top: MVBS with McClane controller (left) and 24-port McClane manifold on skid mounted in back of Jason science sled on dives J2-1024 – J2-1028. Bottom: schematic illustrating the connection of the MVBS to the Jason junction box and MPS. See dive J2-1024 – J2-1028 config files for more information.

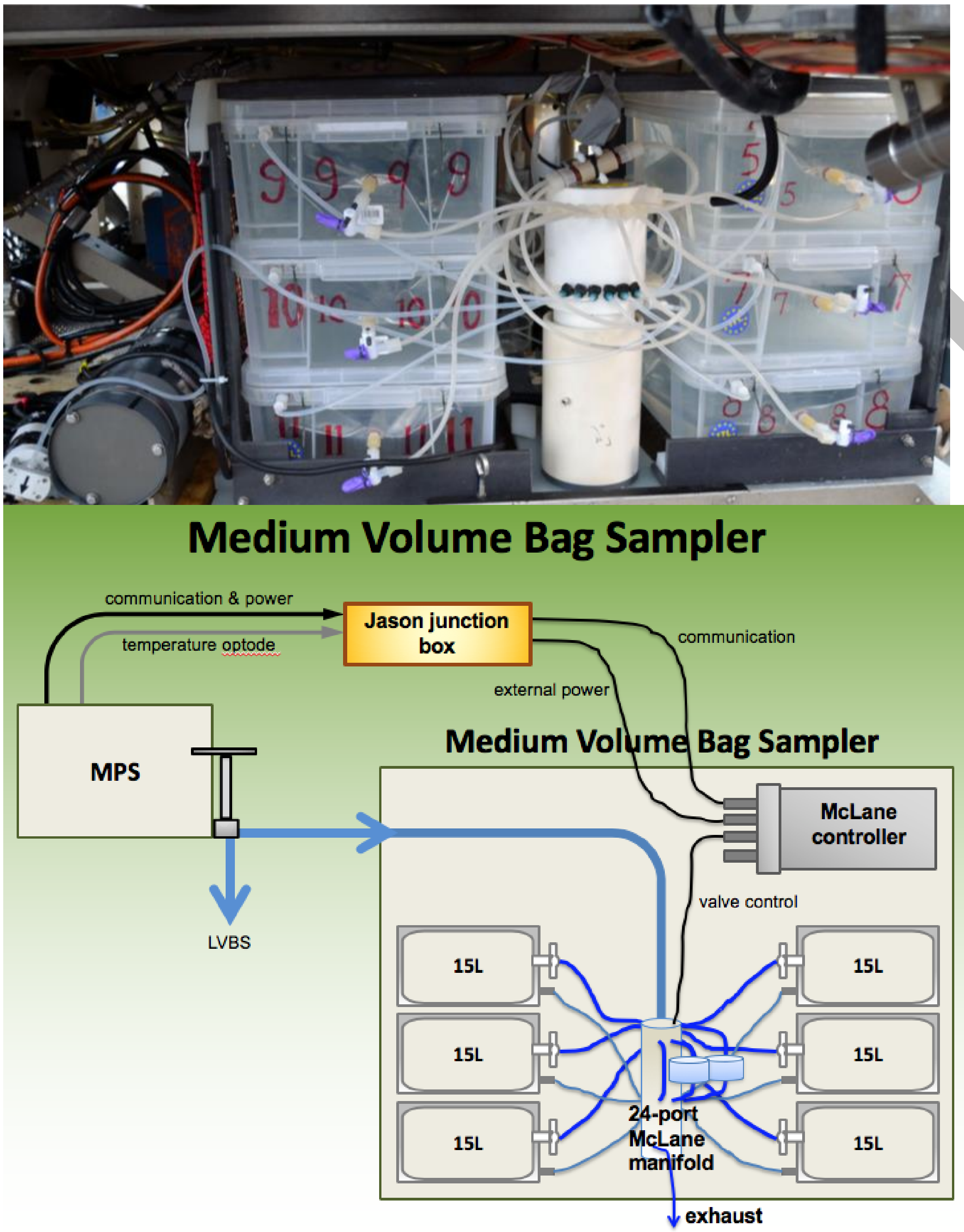


Figure 8. Set up of the Franatech METS methane sensor connected to the SBE19 pump wired in to Jason's Seabird CTD and mounted on the Jason frame, as used on AT39-01. Note that the redox sensor will not be part of the configuration for AT42-12.

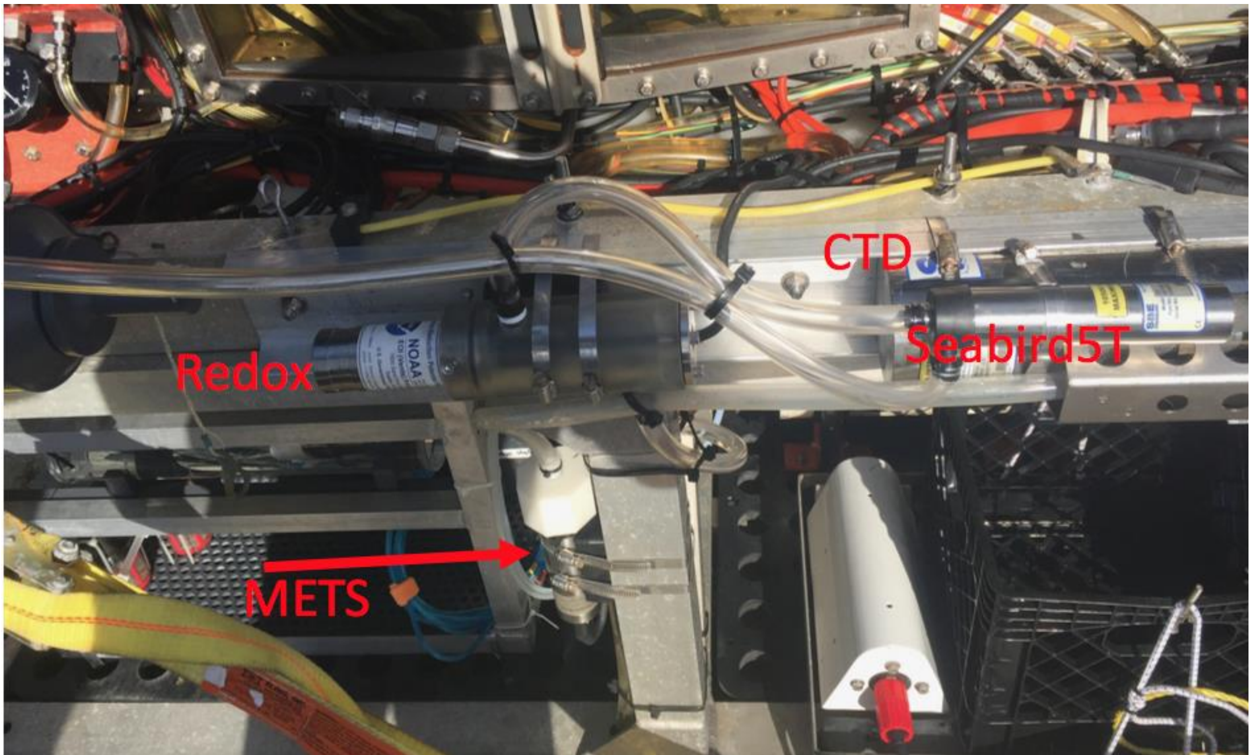
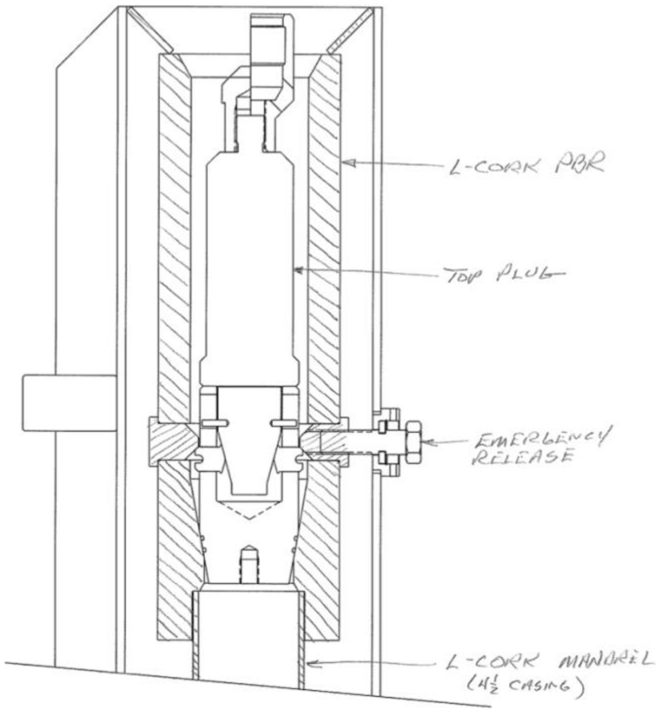


Figure 9. Top plugs to be recovered and deployed. Top Left: Schematic of how the top plug is mounted inside the top of the CORK, showing how dogs to be released with nut driver hold the plug in place. Top Right: photo of a top plug intended for Hole U1301A. Bottom: Photo of a top plug with GS running tool mounted on the Jason basket on dive J2-1033.



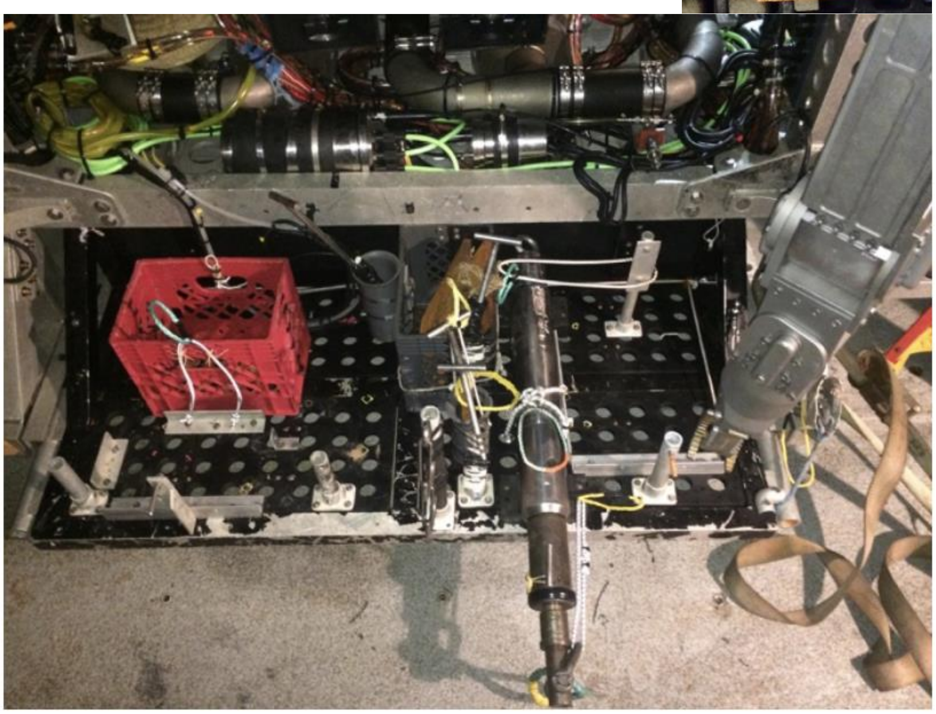


Figure 10. Top left: Schematic of GS running tool (shown connected to top plug in Figure 9). Top right: schematic of RS pulling tool. Bottom: Example of RS pulling tool mounted on Jason basket on dive J2-1031 (on right next to weak link assembly, which is not needed on this cruise).

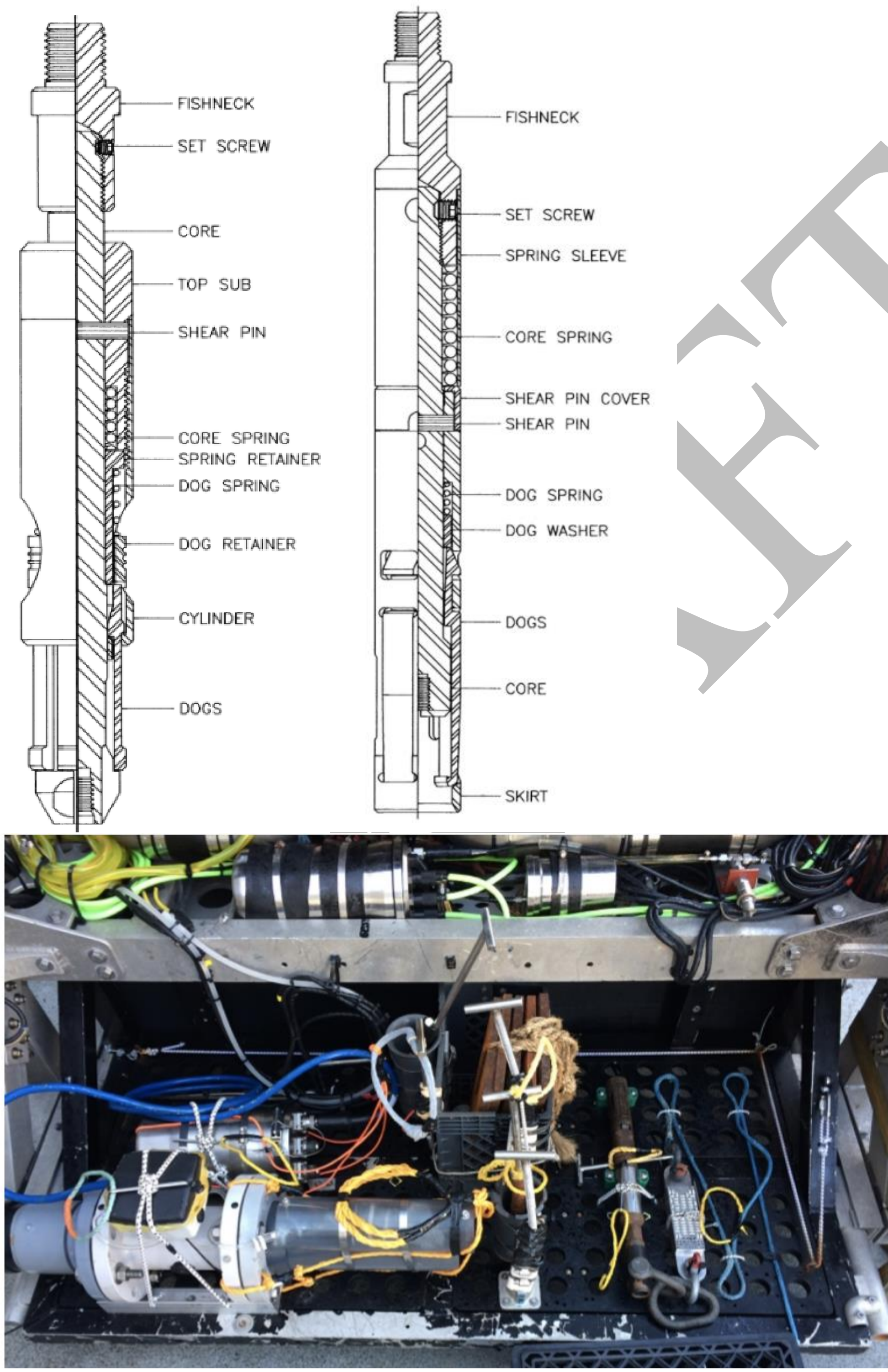


Figure 11. PENDING. Incubation device

Figure 12. Squeezer syringes. Top: Assembled squeezer before triggering. Middle: Example of squeezer syringes mounted in the swingarm of Jason. Bottom: Example of firing squeezer in the top of a CORK.

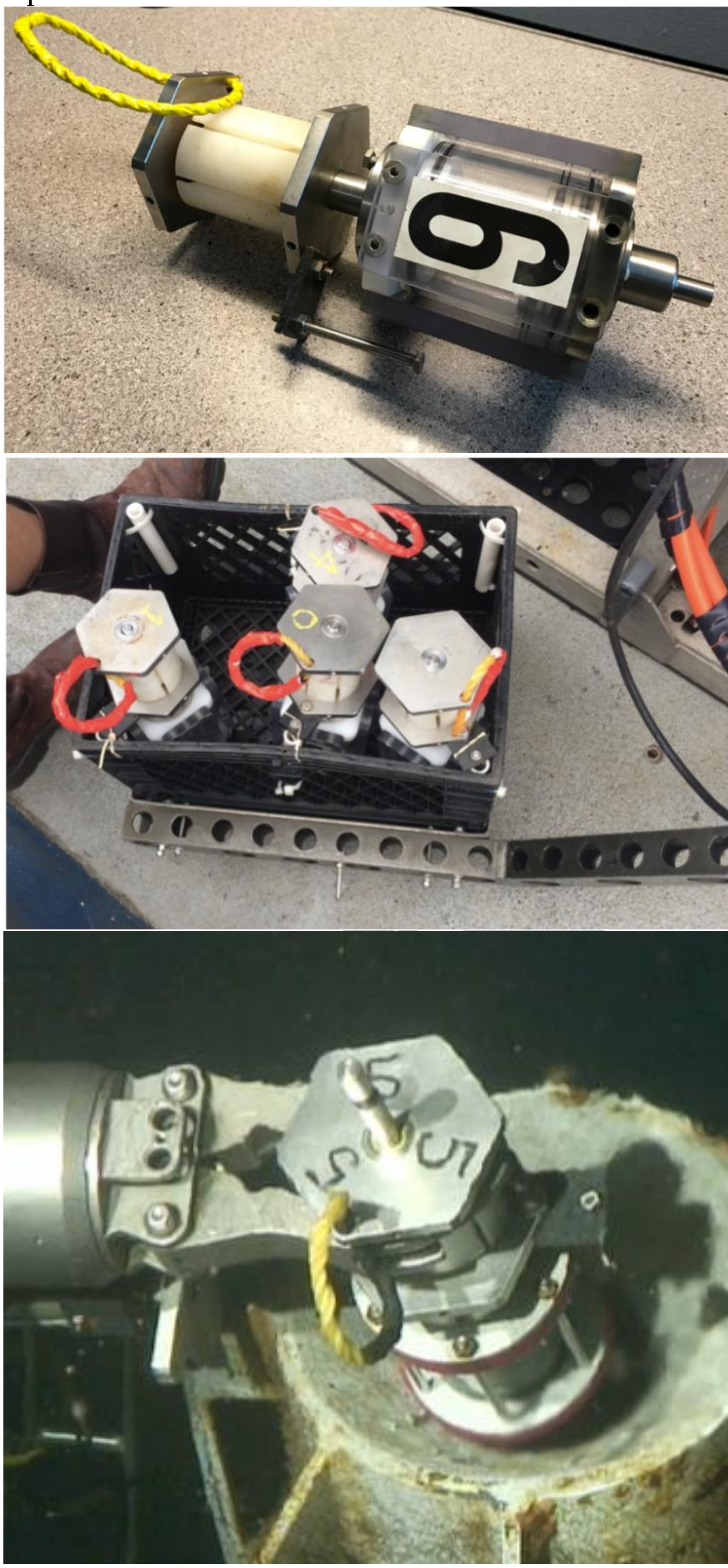


Figure 13. Virus filtration unit mounted on Jason swing arm on dive J2-1028

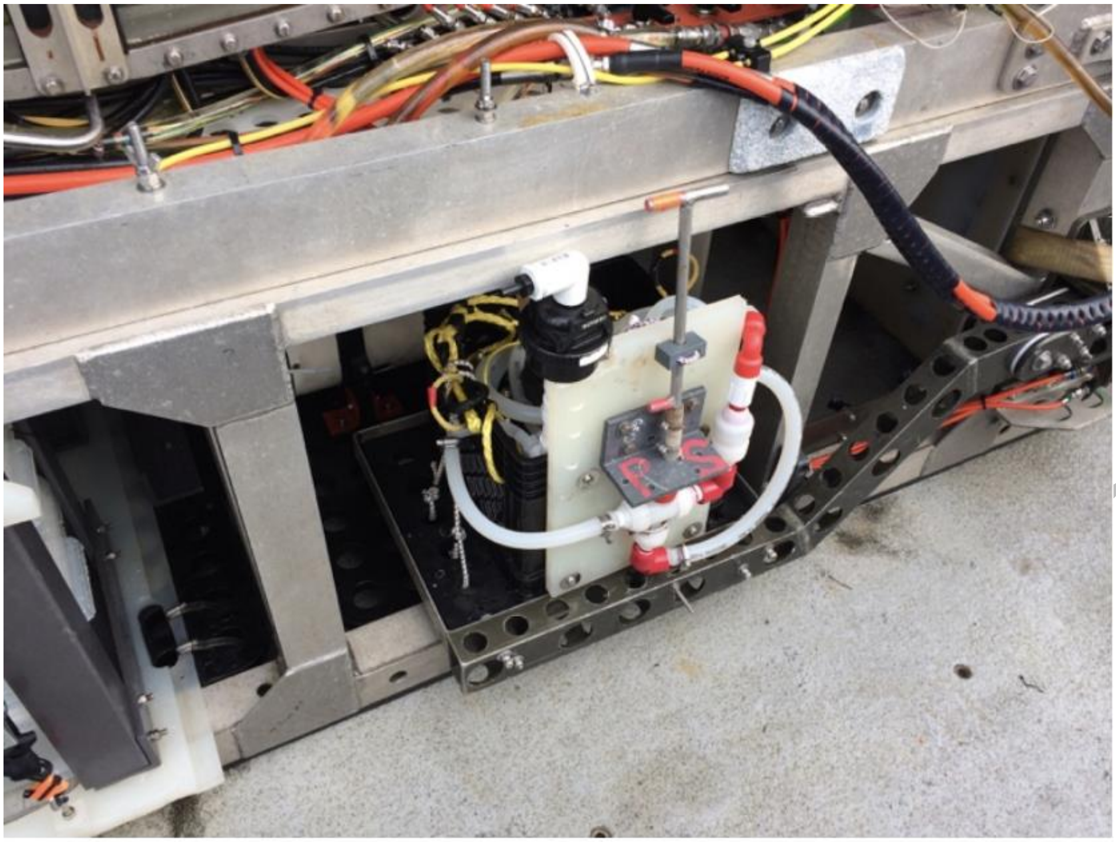


Figure 14. Example of doublewide "OsmoSamplers" milkcrate (in blue on right) hung on CORK wellhead and connected to umbilicals with Jannasch connectors.

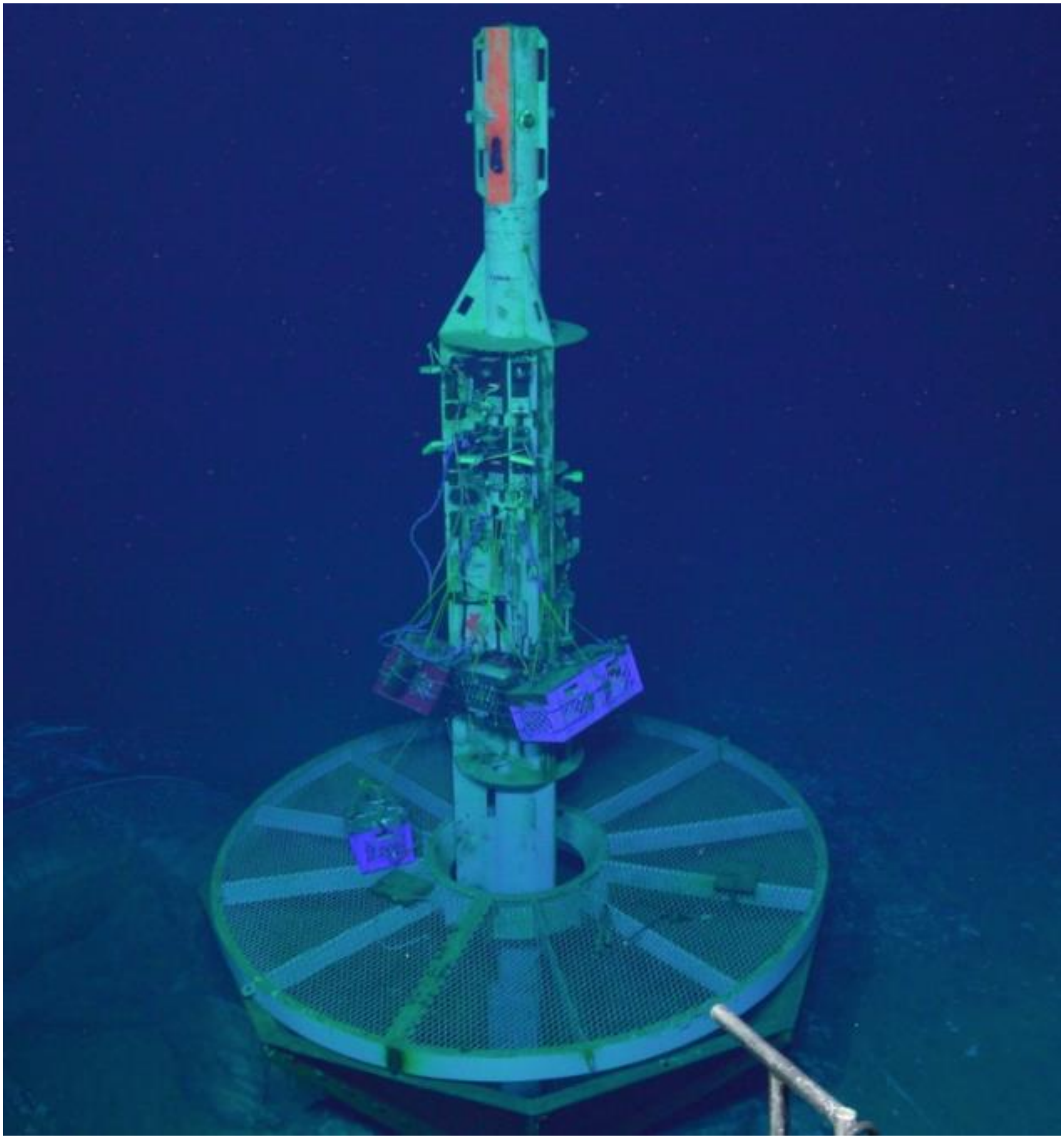


Figure 15. Flow meter deployed on a CORK on dive J2-1031. See Figure 10 for deployment conditions on Jason basket.

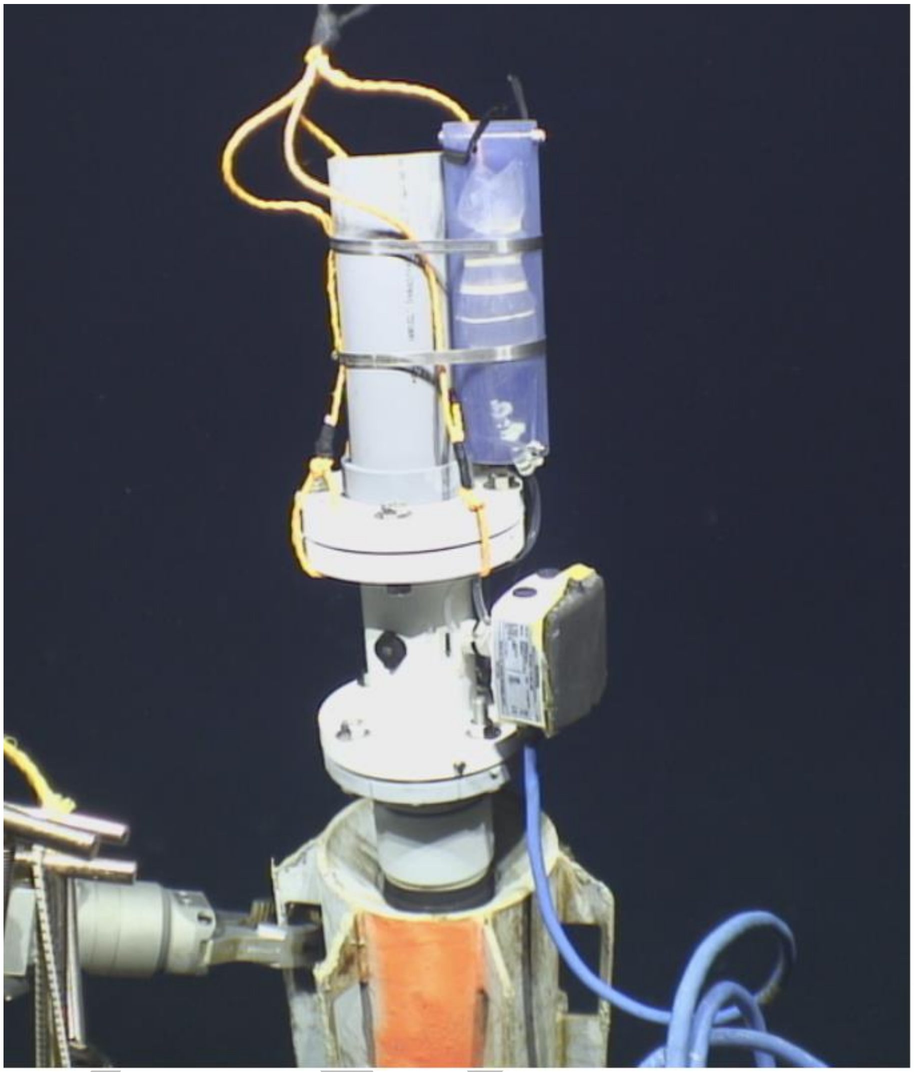


Figure 16. PENDING. Gas tight samplers.

Figure 17. Example of using Jason push cores to collect sediment.

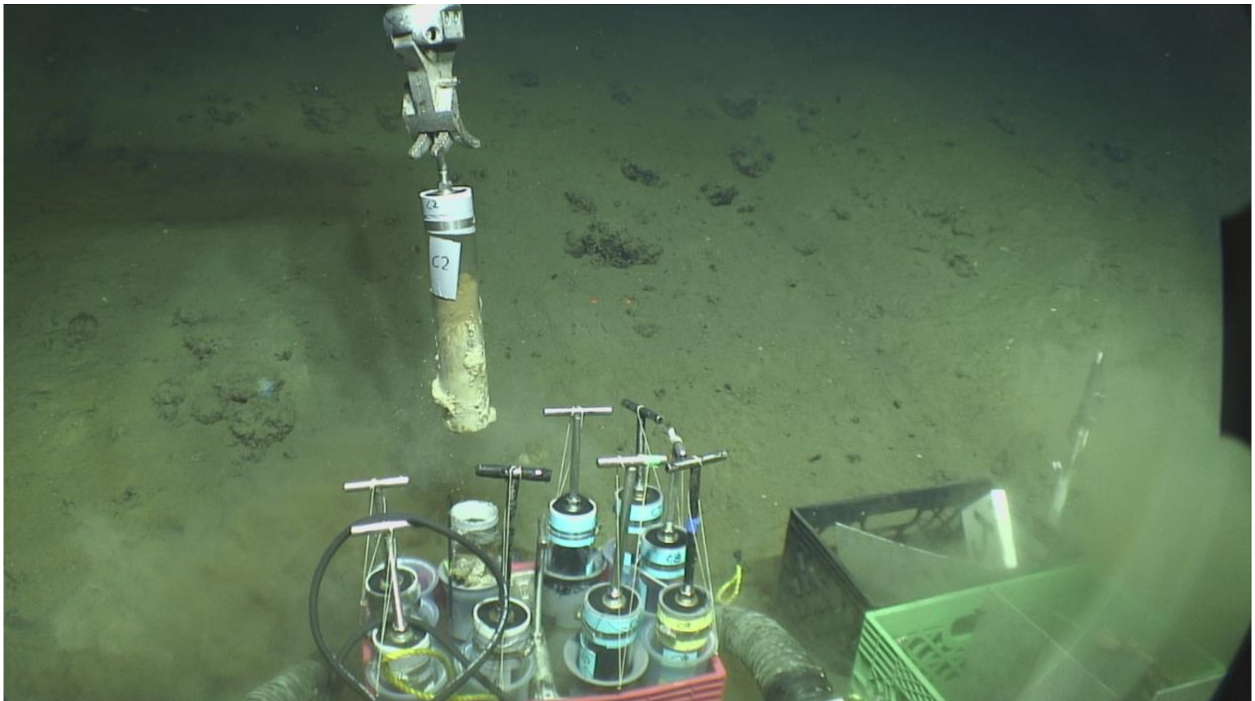


Figure 18. Example WHOI Elevator configuration and deployment on cruise AT39-01.