Scientific Prospectus for R/V *Atlantis*/Alvin Expedition AT26-18:

Completing single- and cross-hole hydrogeologic and microbial experiments: Juan de Fuca Flank

Expedition Dates and Ports: 10 August 2014 to 24 July 2014, Astoria, OR to Astoria, OR
(mobilization: 8–9 August 2014, demobilization 24–25 August 2014)

Supported by NSF project: OCE-1260548 Wheat
(and linked proposals to Fisher, Becker, Clark, Cowen, and Edwards)

Project Co-PIs:

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I. Expedition Overview

NSF award OCE 1260548 ("Collaborative Research: Completing single- and cross-hole hydrogeologic and microbial experiments: Juan de Fuca Flank") supports multidisciplinary borehole experiments in oceanic crust, to assess hydrogeologic, solute and colloid transport, biogeochemical, and microbiological processes and properties at multiple spatial and temporal scales (meters to kilometers, minutes to years). Results of these experiments will comprise a major advance in our understanding of hydrogeologic properties and fluid processes within the volcanic oceanic crust. This work follows completion of Integrated Ocean Drilling Program Expedition 327, which operated in Summer 2010, R/V *Atlantis*/ROV *Jason II* Expedition AT18-07 in Summer 2011, R/V *Atlantis*/ROV *Jason II* Expedition AT25-04 in Summer 2013 and numerous earlier drilling and submersible/ROV expeditions.

Primary work locations are summarized in **Table 1** (in text) and shown in **Figures 1**, **and 2**. Integrated Ocean Drilling Program Expedition 327 drilled two holes through sediment and into the volcanic crust on 3.5 m.y. old seafloor on the eastern flank of the Juan de Fuca Ridge (Figures **1**, and **2**). These holes were drilled, cased, cored, and tested, then instrumented with subseafloor, borehole observatory systems (CORKs). Expedition 327 also included a hydrogeologic, pumping and tracer injection experiment, to assess multi-scale formation properties, including the nature of azimuthal and vertical crustal anisotropy.

The Expedition 327 CORKs augment four additional observatory systems, all located within an area of about 2.5 square kilometers, creating a network of six instrumented sites where researchers monitor pressure and temperature at depth, sample fluids and microbiological material using autonomous instrumentation, and conduct in situ microbial experiments (**Figure 3**). These CORK systems require servicing with a submersible or remotely operated vehicle (ROV) to download data, recover samples, and replace a variety of experimental systems (pressure and temperature data are collected from one of the systems using a cabled network).

This expedition includes 12 full dives and one partial dive, for a total expedition length of 13 days on site. During this period we will focus on the primary topic related to the tracer-transport experiment. Secondary work will include replacing the pressure logger at 1027C and collecting large volumes of fluids for recovery of particulate tracers and for microbial and virus analysis.

Specifically we will:
- Conduct a hydrostatic check at 1026B, 1031A, 1031B, 1362A, and 1362B;
- Download pressure at 1026B, 1031A, 1031B, 1362A, and 1362B;
- Deploy new pressure logger and recover the old one at 1027C;
- Measure temperatures of the exiting fluids with the Alvin probe (max temp of 65C;
- Recover the flow meter chimney with thermistors (1362A);
- Recover wellhead OmsoSamplers at 1026B, 1362A and 1362B;
- Recover downhole samplers at 1026B, 1362A, and 1362B;
- Attempt to recover downhole sampler at 1301A;
- Sample fluids that vent from the open boreholes and through the umbilicals at 1026B, 1362A, 1362B and 1301A;
- Deploy the UH GeoMICROBE sampling sled for large volume collection and discrete samples filtered in situ;
- Conduct a background CTD; and

- Collect 6 push cores near the wellheads

If necessary weather or mechanical issues arise, we will collect multi-beam bathymetric data. If we are successful and accomplish all of the primary goals, we may elect to explore Mama, Papa, Baby, of Zona Bares where we will look for signs of fluid seepage, collect sediment push cores and make measurements of temperature in the sediment for heat flow analysis. However, it is unlikely that we will have time to explore secondary sites.

II. INTRINSIC SCIENTIFIC VALUE AND IMPACT

The work we propose to complete comprises the first controlled cross-hole hydrogeologic experiment and the first tracer experiment to be completed in the oceanic crust. These are the first hydrogeologic studies of the crust to assess vertical compartmentalization, and to quantify azimuthal (directional) fluid flow properties. These experiments also will provide the most pristine and best long-term record of ridge-flank crustal (borehole) fluids anywhere on the planet. These experiments are globally unique. The eastern flank of the Juan de Fuca Ridge has become a de-facto "type setting" for ridge flank hydrothermal processes, in part because there is a long history of multidisciplinary research in this area. That said, crustal conditions in this area comprise a warm ridge-flank hydrothermal end-member because so much of the volcanic crust is sealed by young (3.5 Ma) thick sediments. In contrast the North Pond field site, on young (8 Ma) crust west of the Mid-Atlantic Ridge, has extensive exposure of basement rocks, which results in the upper ocean crust being cooled by extensive exchange of circulating fluids. Here there are additional CORK installations in basement. These two local are the only places in the oceanic crust where these kinds of experiments can be completed without considerably greater investments in drilling time, infrastructure, and scientific instrumentation.

The proposed work on the eastern flank of the Juan de Fuca Ridge will provide samples and data that are unique; are essential for understanding ocean crustal hydrogeology, biogeochemistry and microbiology; and cannot be obtained in any other way. Earlier short-term hydrologic tests in ocean crustal boreholes, and tests from open holes resulting from natural or induced differential pressures, have provided no information on formation compressibility, which is essential for understanding the crustal response to transient pressure events. The use of natural formation overpressure to run long-term free flow experiments, as we are doing, quantifies formation transmissive and storage properties across a continuum of crustal scales. The bulk formation properties indicated by earlier cross-hole responses in this area suggest permeability that is lower than determined with single hole tests, and several orders of magnitude less than estimated by numerical modeling and analyses of formation responses to tidal and tectonic perturbations. This discrepancy (which is contrary to expected scaling of permeability with the lateral scale of testing) may be reconciled if the upper crust in this area is azimuthally anisotropic with respect to basement permeability, with higher permeability in the "*along-strike*" direction (trending N20E). Testing this hypothesis is a fundamental goal of the complete experimental program. Applying a suite of techniques using a single network of boreholes is the only way to accurately determine the nature of crustal permeability and storage properties, resolve scaling influences, and test the validity of idealized crustal representations commonly used in models. The seafloor is an ideal place to address these issues, because individual tests can be run for years, delineating the scale-dependence of hydrologic properties using one experimental method.

Similarly, there is no other way to assess actual fluid, solute, and particle flow directions and rates except through a tracer experiment. *This kind of experiment has never before been attempted in the ocean crust.* The extent of water mixing and water-rock interaction within an aquifer depends on the *effective porosity* (fraction of open space involved in fluid flow) and hydrodynamic *dispersivity* (spreading of solutes by mechanical dispersion and diffusion). Understanding these properties is critical to successful reactive-transport modeling and interpreting the age distributions of fluids, but *these properties have never been quantified in the oceanic crust. Simply observing tracer arrival across meters to kilometers is a significant accomplishment, but samplers remain within the boreholes to provide more robust and additional quantification of fluid flow!* Effective porosity varies with flow direction in heterogeneous systems as a result of flow channeling and must be tested directly. Like permeability, dispersivity must be determined at the scale(s) of interest using tracers. Future tracer experiments could then make use of the three-dimensional, subseafloor network established as part of this project, running for years to decades using seafloor pumps and samplers. Learning to run these experiments on a ridge flank is important for planning similar tests in other locations and settings (e.g., ridge axes, subduction zones, continental shelves, hydrate seeps).

Microbial sampling and incubation experiments using seafloor borehole observatories are extending the frontiers of fundamental knowledge. Samples recovered from Hole 1301A document community succession and biogeochemical response to formation recovery following drilling operations. Seafloor and borehole sensors and samplers collect time-series data and fluids from multiple depths. Through combined molecular biological and geochemical approaches, these samples are providing new insights into the extent and nature of subseafloor ecosystems, their responses to geochemical conditions, and the influence of microbial activity on fluid and basement geochemistry. Flow-through incubation using next-generation experimental chambers include large volume fluxes designed to concentrate biomass in-situ, and will help with in-depth down-stream molecular analysis (genomic, proteomic). These systems also will permit quantitative determination of growth rates and the nature of associated rock alteration.

III. Operational Needs

The following is a list of unique materials and equipment that are needed to accomplish our scientific goals.

- Alvin - Electrical connection for ODI for pressure data download (Standard: Contact Contact Keir Becker, U. Miami or Earl Davis/Bob Meldrum, PGC)
- Alvin - Electrical through-hull ODI connection for UH GeoMICROBE sled system, and in-hull connection to UH laptop (in queue for gas testing). The UH group is in direct communication with Alvin electrical engineer Lane Abrams in order to ensure interface compatability
- Alvin – electrical connection for temperature probe. The maximum temperature of venting fluids should be 65°C
- Wheat will bring the Plasma winch (3000-m-long rope, back up materials for winch, syntactic foam floats (big and two small [one small one for the milk crate with the 50-m-long rope and another at the surface with the light to be identified at night]), milk crate, D-rings, shackles, lights, weak links and plastic, tension meter, sheave). We will need the Alvin release, weights, and homer/tracking probe.
- UH will bring gastights.

- UH will bring two GeoMICROBE instrument sleds; the titanium frames will serve as elevators
- Alvin – titanium Major samplers and sediment push cores
- Alvin – Elevator, weights and homer/tracking probe.
- Night time operations – one CTD, winch activities and elevator (which could be deployed in the morning just before the Alvin is launched or just after dinner and before the plasma line is deployed.

  **** We hope to pull up 4 downhole samplers. This requires the plasma rope to be deployed at least 4 times after Alvin is recovered. Deployment of the rope should take about 2 hours to release the weighted package, 3000-m-length of plasma rope, and two surface floats. In the past it has taken about 5 hours to recover the line, position the ship over the wellhead, slowly pull the instrument string out of the wellhead, recover the rest of the line at a faster rate, and recover the samplers on the ship. Note that for 1362A and B the downhole systems have eyes spliced in the line every 12.5 m. The 1026B downhole system may take another hour (6 hours total) to recover because of the lack of pre-sewn loops in the strength member. However, the string in 1026B has a spectra line that is load bearing. The spectra line may be used to pull up the string using the capstan.

IV. AT25-04 Draft Dive Plan

In 2013 we left the port of Astoria and arrived on site at 6 am to deploy an elevator. The plan will be to leave Astoria in the morning and arrive on site the next day in time to deploy an elevator and to get a full dive. The following is a plan for the dive series, actual dive activities will change depending on the situation at sea, probably after the first dive. Daily meetings at 4 pm will recount the current dive operations, and plan the next 24-hours of operation.

Dive	Time (hours)	Operation
Deploy	Elevator	Configure for recovering flow meter and OS crates (2)
Dive 1	1362A	
	0.5	locate 1362A
	0.25	pressure valves to hydrostatic
	0.5	locate 1362B
	0.25	pressure valves to hydrostatic
	0.5	locate 1362A
	0.75	set umbilisnork aside and sample outflow with cow syringes, squeezers and Ti Major (2)
	0.25	close ball valve on the flow meter
	0.5	remove imbilisnork and place in OS crate
	0.25	pressure valves to closed
	0.75	pressure download 1362A
	0.5	locate 1362B
	0.25	pressure valves to closed
		if time recover OmoSampler crates
	5.25	time on bottom
Deploy	UH	GeoMICROBE sled for sampling 1362B
Deploy	Plasma	plasma line with latch and rope to 1362A
Dive 2	1362A and	

	1362B	
	1	locate plasma line and move to 1362A
	0.75	pressure download 1362A
	0.5	Remove OsmoSampler crates
	0.5	connect plasma line to top of CORK Latch (remove other OS if no elevator during dive 1)
	0.25	move to 1362B
	0.5	close valves in chem and mbio bays - remove OS to basket
	1	Find and connect UH GeoMICROBE sled
	4.5	time on bottom
Recover	Plasma	plasma line and downhole instruments from 1362A
Dive 3	1027C and 1026B	
	0.5	locate 1027
	0.25	pressure valves to hydrostatic
	0.6	close valves - 32 minutes after opening.
	0.5	pressure download 1027C
	2	transit to 1026B
	0.25	close valves in chem bay-
	0.5	recover 3 OS plates on basket.
	4.6	time on bottom
Deploy	Plasma	plasma line with latch and rope to 1362B
Dive 4	1362A and 1362B	
	1	locate plasma line and move to 1362B
	1.5	Collect 2 gastight samples from GeoMICROBE sled's hydrothermal fluid trap, remove UH sled and send to surface
	0.7	download pressure data 1362B (recover OS if not picked up earlier)
	0.5	connect plasma line to top of CORK Latch
	0.25	move to 1362A
	0.75	sample outflow with cow syringes and squeezers at 1362A
	0.5	deploy plug 1362A
	5.2	time on bottom
Recover	Plasma	plasma line and downhole samplers from 1362B
Recover	UH	GeoMICROBE sled from sampling 1362B
Deploy	UH	GeoMICROBE sled for sampling 1362A
Dive 5	1301A	
	0.5	locate 1301A
	0.25	pressure valves to hydrostatic
	0.25	while waiting 32 minutes after opening -close chem valves.
	0.5	recover OS plates on basket
	1	close pressure valves and wait to download 32 minutes later
	1.25	transit to UH sled and move to 1362A - hook to 1362A
	0.5	sample fluids 1362A
	4.25	time on bottom
Deploy	Plasma	plasma line with latch and rope to 1026B
Dive 6	1301A and 1301B	
	1	locate plasma line and move to 1026B
	0.5	connect plasma line to top of CORK Latch

	1	transit to 1362B
	0.75	sample outflow with cow syringes and squeezers
	1.75	transit to 1362A, collect 1 gastight and 1 Ti-major from GeoMICROBE sled's hydrothermal fluid trap, release UH sled and send to the surface
	5	time on bottom
Recover	Plasma	plasma line and string at 1026B
Recover	UH	GeoMICROBE sled from sampling 1362A
Deploy	UH	GeoMICROBE sled for sampling 1362B
Dive 7	1362B and 1026B	
	1	locate UH GeoMICROBE sled and move to 1362B
	0.25	transit to 1362B
	0.75	sample outflow with cow syringes and squeezers and Ti majors
	0.5	seal 1362B
	0.5	transit to 1301B
	0.25	pressure to hydrostatic
	1	wait and finally download pressure data
	4.25	time on bottom
Day 8	1362B and 1026B	
	1.5	transit to 1026B
	0.5	sample outflow with cow syringes and squeezers and Ti majors
	0.5	seal 1026B
	0.5	transit to 1362B
	1.5	Collect 1 Ti-major from GeoMICROBE sled's hydrothermal fluid trap, release UH sled and send to the surface
	4.5	time on bottom
Recover	UH	GeoMICROBE sled from sampling 1362A
Deploy	Plasma	plasma line with latch and rope to 1301A
Day 9		1301A downhole recovery
Recover	Plasma	plasma line and string at 1301A
Day 10	1301A	
	0.5	transit to 1301A
	0.5	sample outflow with cow syringes and squeezers and Ti majors
	0.5	seal 1301A
	1.5	time on bottom
Day 11	weather	
Day 12	mechanical issues	
Day 13	half dive	

V. Staffing, Logistics, Planning, and Safety

We anticipate sailing 24 scientific and education, outreach, and communication (EOC) personnel, in addition to the regular WHOI technical support and *Alvin* support teams. The current staffing list is summarized in **Table 5**.

General information on WHOI Cruise Planning can be found here:
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 Submersible *Alvin* is available here:
http://www.whoi.edu/main/hov-alvin

Information for project co-PIs is available here:
http://www.whoi.edu/page.do?pid=8218

Information for members of the science/EOC party is available here:
http://www.whoi.edu/page.do?pid=8219

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

Hazardous materials
Anyone bringing hazardous materials must read this page and associated links, and fill out forms as needed:
http://www.whoi.edu/page.do?pid=8336#0

Ship agent is Vasile Tudoran. His info and the port info are located here.
http://www.whoi.edu/cruiseplanning/synopsis.do?id=2662
http://www.whoi.edu/page.do?pid=8230

Radioisotopes
We don't plan to have any radioisotope work done during AT26-18.

All members of the AT26-18 shipboard party must have 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.

Table 1. Primary work sites for Summer 2014 with the R/V *Atlantis* and the submersible *Alvin* on AT26-18. Clearance is requested for 10 nautical miles around each CORK.

Location ID	Latitude	Longitude	Water depth (m)	Date installed	Expedition installed
CORK 1026B	47°45.759'N	127°45.552'W	2658	1996/2004	Leg 168/Exp. 301
CORK 1027C	47°45.387'N	127°43.867'W	2656	1996/2011	Leg 168/AT18-07
CORK 1301A	47°45.209'N	127°45.833'W	2658	2004	Exp. 301
CORK 1301B	47°45.229'N	127°45.826'W	2658	2004	Exp. 301
CORK 1362A	47°45.662'N	127°45.674'W	2658	2010	Exp. 327
CORK 1362B	47°45.499'N	127°45.733'W	2658	2010	Exp. 327

Table 2. Summary of tasks according to the initial plan to be completed on a particular dive at each of the primary CORKs in Summer 2014 with the R/V *Atlantis* and the submersible *Alvin* on AT26-18.

	Pressure	well head OS	downhole OS	plugs	Fluid Sampling	UH GeoMICROBE sled
1026	-----	Dive 3	Dive 6	Dive 8	Dive 8	-----
1027	Dive 3	-----	-----	-----	-----	-----
1301A	Dive 5	Dive 5	Dive 9	Dive 10	Dive 10	-----
1301B	Dive 7	-----	-----	-----	-----	-----
1362A shallow	Dive 2	Dive 1	Dive 2	Dive 4	Dive 1, 4	-----
1362A deep	Dive 2	Dive 1	Dive 2	Dive 4	-----	Deploy dive 5, recover dive 6
1362B	Dive 4	Dive 2	Dive 4	Dive6	Dive 6	Deploy dive 2, recover dive 4; Deploy dive 7, recover dive 8

Table 3. Distances between CORK systems (in meters) located at the primary work sites for Summer 2014 with the R/V *Atlantis* and the submersible *Alvin* on AT26-18.

	Hole 1026B	**Hole 1362A**	**Hole 1362B**	**Hole 1027C**	**Hole 1301B**	**Hole 1301A**
Hole 1026B		235	532	2199	1039	1076
Hole 1362A	235		311	2296	825	861
Hole 1362B	532	311		2322	514	550
Hole 1027C	2199	2296	2322		2446	2458
Hole 1301B	1039	825	514	2446		36
Hole 1301A	1076	861	550	2458	36	

Table 4. Secondary work sites for Summer 2014 with the R/V *Atlantis* and the submersible *Alvin* on AT26-18. Clearance was sought in case all primary tasks are completed and time remains on the schedule.

Location ID	Latitude	Longitude	Water depth (m)	Clearance radius (nmi)
Mama Bare	47°50.0'N	127°45.0'W	2675-2530	2
Papa Bare	47°51.0'N	127°37.0'W	2665-2400	3
Zona Bare	48°11.0'N	127°33.0'W	2580-2500	2

Table 5. Anticipated scientific and EOC staffing for AT26-18 (as of 7/01/14). Open berths may be filled by some combination of scientific, technical or EOC personnel.

Number	Last name	First name	Institution	Role	Email
1	Wheat	Charles Geoffrey	UAF	Scientist	wheat@mbari.org
2	Fournier	Trevor	UAF	Grad	tfournier@csumb.edu
3	Inderbitzen	Katherine	UAF	Postdoc	kinderbitzen@alaska.edu
4	Hsieh	Chih-Chiang	U Hawaii	Grad	oliver.hakka@gmail.com
5	Jungbluth	Sean	U Hawaii	Grad	seanpj@hawaii.edu
6	Fisher	Andrew	UCSC	Scientist	afisher@ucsc.edu
7	Mura	Gavin	U Hawaii	Student	gmura@hawaii.edu
8	Johnson	Sarah	MLML	Student	Srj73@nau.edu
9	Orcutt	Beth	Bigelow	Scientist	borcutt@bigelow.org
10	Fitzgerald	Eric W.	MBARI	Engineer	efitzgerald@mbari.org
11	Ramirez	Gustavo	USC	Grad	garamire@usc.edu
12	Clark	Jordan	UCSB	Scientist	jfclark@geol.ucsb.edu
13	Becker	Keir	U Miami	Scientist	kbecker@rsmas.miami.edu
14	Billings	William Zachary	U Miami	Grad	w.billings@rsmas.miami.edu
15	Lin	Huei-Ting	U Hawaii	Postdoc	hueiting@hawaii.edu
16	Rappé	Michael	U Hawaii	Scientist	rappe@hawaii.edu
17	Omori	Everett	U Hawaii	Technician	everetto@hawaii.edu
18					

Figure 1. Area of operation.

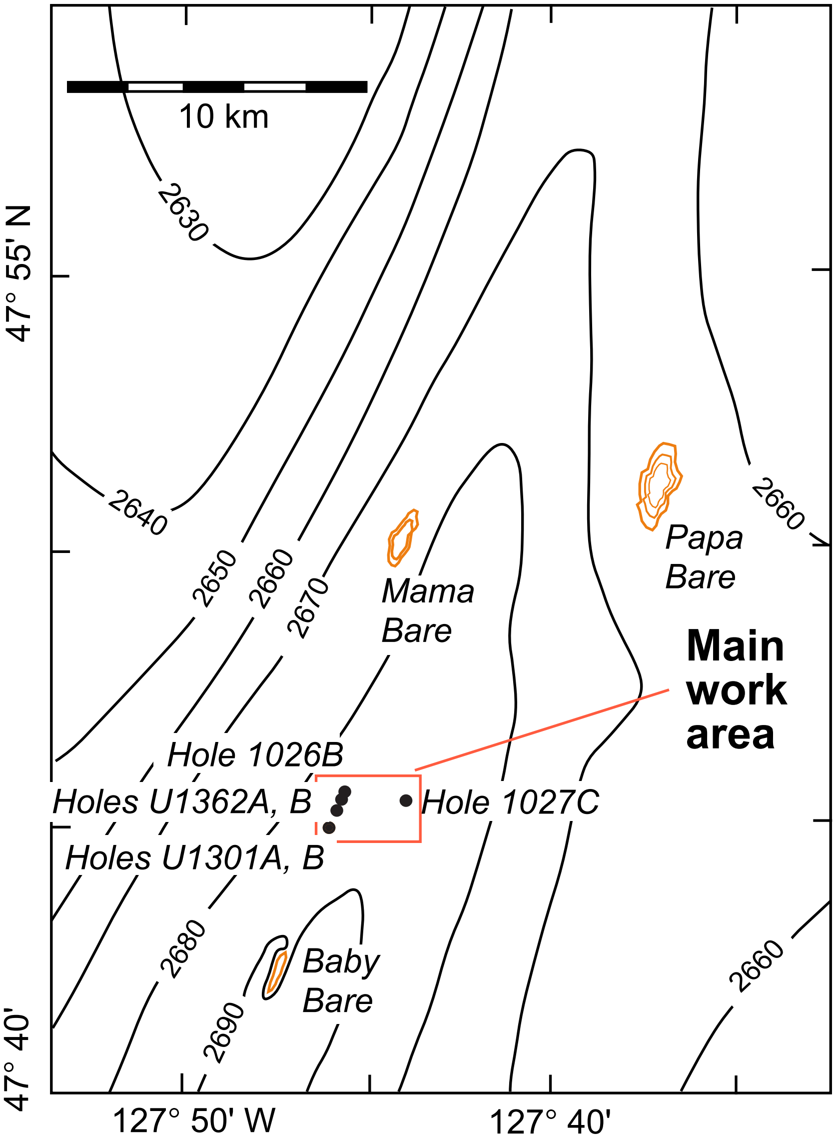

Figure 2. Borehole locations within the context of the three Bares.

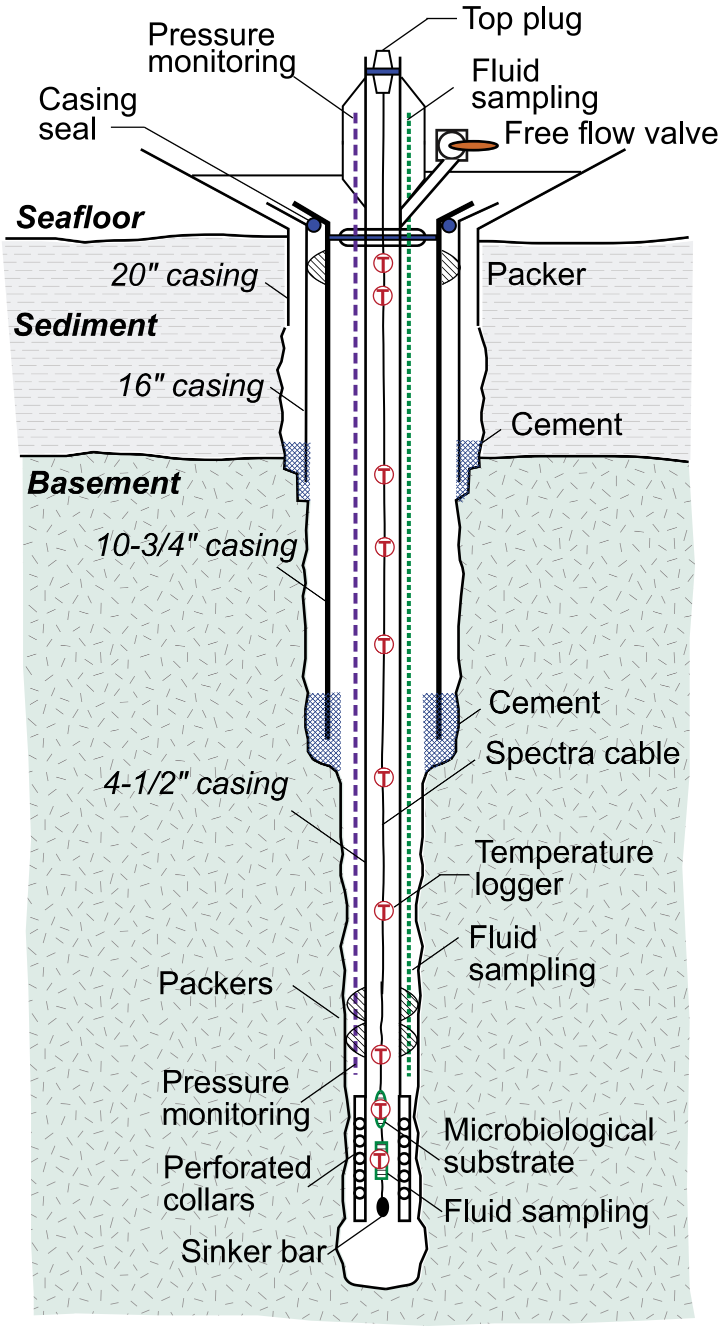

Figure 3. Generalized CORK diagram.

Table T3. Depths, types, and serial numbers of temperature loggers and related string parameters deployed in Expedition 301 and 327 CORKs as of end of Expedition 327. (See table notes.)

Manufacturer (serial number)	Depth		
	msd	mbsf	msb
Hole U1362A			
Onset (768608)	8.4	2.2	–233.8
Onset (768609)	19.7	13.4	–222.6
Antares (1857021)	227.2	220.9	–15.1
Antares (1857022)	237.4	231.2	–4.8
Antares (1857023)	294.9	288.6	52.6
Antares (1857024)	305.1	298.8	62.8
Antares (1857027)	344.1	337.9	101.9
Antares (1857028)	380	373.8	137.8
Antares (1857031)	415.9	409.7	173.7
End of Spectra cable	438.8	432.6	196.6
Antares (1857025)	NA	438.6	202.6
Antares (1857026)	NA	454.1	218.1
End of sinker bar	NA	469.7	233.7
Hole U1362B			
Antares (1857034)	9.0	2.9	–239.1
Antares (1857038)	14.0	8.0	–234.0
Antares (1857039)	20.0	14.2	–227.8
Antares (1857040)	30.0	24.4	–217.6
Onset (768607)	246.3	245.0	3.0
Onset (768610)	273.8	273.0	31.0
End of Spectra cable	282.6	276.3	34.3
Antares (1857035)	NA	276.9	34.9
Antares (1857037)	NA	301.4	59.4
End of sinker bar	NA	310.0	68.0
Hole U1301A			
Onset (768616)	8.0	2.3	–259.9
Antares (1857030)	16.0	10.3	–251.9
Onset (768604)	255.4	249.7	–12.5
Onset (768598)	265.4	259.7	–2.5
Antares (1857004)	270.4	264.7	2.5
End of Spectra cable	275.3	NA	NA
Onset (768596)	NA	274.5	12.3
Antares (1857036)	NA	283.6	21.4
Onset (768603)	NA	284.5	22.3
End of sinker bar	NA	290.7	28.5
Hole U1301B			
Antares (1857029)	10.2	2.8	–262.4
Antares (1857032)	20.4	13.0	–252.2
Antares (1857033)	30.6	23.2	–242.0
End of Spectra cable	51.0	43.6	*–221.6*
End of sinker bar	54.7	47.3	*–217.9*

Notes: msd = meters Spectra depth, mbsf = meters below seafloor, msb = meters subbasement (msb values <0 indicate deployment within the sedimentary section). Depths for Holes U1362A, U1362B, and U1301B are corrected for Spectra cable stretch of 2%. Depths for Hole U1301A are not corrected for stretch because cable has plug in landing seat at bottom and cable should be relatively slack. A thermistor cable is recording borehole temperatures at 16 depths in Hole 1026B, with data accessible through the NEPTUNE Canada website (www.neptunecanada.ca/). End of Spectra cable is length/depth. OsmoSampler systems and a sinker bar are suspended below this cable in Holes U1362A and U1362B, and a sinker bar is suspended in Hole U1301B. In Hole U1301A, the Spectra cable terminates in top of bottom plug, with some slack included to assure that the plug landed. Tools listed after end of Spectra cable were deployed in PVC holders mounted inside OsmoSampler systems, below depth extent of Spectra cable. Hole U1301A instrument string was deployed with submersible *Alvin* in summer 2009. All others were deployed during Expedition 327. NA = not applicable.

Table T4. Specifications of OsmoSampler deployed in Expedition 301 and 327 CORKs as of end of Expedition 327. (See table notes.)

Component	Length (m)	Depth mbsf	Depth msb
Hole U1362A			
Acid addition	5.4	438.0	202.0
MBIO (Antares 1857025)*	6.7	444.8	208.8
Standard	3.4	448.2	212.2
Enrichment	5.4	453.6	217.6
BOSS (Antares 1857026)*	5.4	459.1	223.1
Gas tight (copper)	3.4	462.5	226.5
Sinker bar (200 lb)	3.7	466.2	230.2
Total length:	33.6		
Bullnose depth		469.7	233.7
Hole U1362B			
Standard (Antares 1857035)*	3.4	279.9	37.9
MBIO	6.7	286.6	44.6
Acid addition	5.4	292.0	50.0
Enrichment	5.4	297.5	55.5
Gas tight (copper)	3.4	300.9	58.9
BOSS (Antares 1857037)*	5.4	306.4	64.4
Sinker bar (200 lb)	3.7	310.0	68.0
Total length:	33.6		
Bullnose depth		311.5	69.5
Hole 1026B			
Gas tight (copper)	2.8	200.6	–46.5
Standard	2.8	203.5	–43.6
MBIO	2.8	206.3	–40.8
MBIO	2.8	209.2	–37.9
Standard	2.8	212.0	–35.1
Sinker bar (50 lb)	1.0	213.0	–34.1
Total length:	15.2		
Hole U1301A			
Gas tight (copper) (Onset 768596)	3.4	276.9	14.7
MBIO (Antares 1857036)	6.7	283.6	21.4
Acid addition (Onset 768603)	5.4	288.9	26.7
Sinker bar (100 lb)	1.8	290.7	28.5
Total length:	17.2		
Bullnose depth		292.0	29.8

Notes: * = temperature logger mounted in PVC holder inside OsmoSampler assembly. System components are listed top to bottom for each hole. Instruments in Holes U1362A and U1362B were deployed during Expedition 327. Instruments in Hole 1026B were deployed with *Alvin* in summer 2008. Instruments in Hole U1301A were deployed with *Alvin* in summer 2009. Depths reported are for base of each component: mbsf = meters below seafloor, msb = meters subbasement. Total length is from top of OsmoSampler string to base of sinker bar. Depth of bullnose tip is at end of CORK casing. All Expedition 327 OsmoSampler systems were deployed above this depth inside perforated and coated casing and collars.

Table T5. Monitoring and sampling points in Expedition 327 CORKs. (See table notes.)

Monitoring/Sampling purpose	Valve ID	Screen material	Depth mbsf	Depth msb	Comments
Hole U1362A					
Pressure	1	Stainless steel	430.1, –3.66	194.1	Deep basement interval
Pressure	2	Stainless steel	307.8, –3.96	71.8	Shallow basement interval
Pressure	3	None	0.1, –4.26	NA	Cased interval
Geochemistry	1, 1′	Stainless steel	434.2	198.2	Deep basement interval, ~5 m below base of lower packer
Geochemistry	2, 2′	Stainless steel	309.3	73.3	Shallow basement interval, ~2 m below base of lower packer
Geochemistry	3, 3′	Stainless steel	309.3	73.3	Shallow basement interval, ~2 m below base of lower packer
Microbiology	1, 2	Titanium	439.8	203.8	Deep basement interval, ~10.6 m below base of lower packer
Hole U1362B					
Pressure	1	Stainless steel	272.0, –3.66	30.0	Basement interval
Pressure	2	None	0.1, –3.96	NA	Cased interval
Pressure	3	None	–4.3	NA	Dedicated seafloor
Geochemistry	1, 1′	Stainless steel	278.8	36.8	Basement interval, ~8 m below base of packer, center of 5-1/2 inch casing
Geochemistry	2, 2′	Stainless steel	278.8	36.8	Basement interval, ~8 m below base of packer, center of 5-1/2 inch casing
Geochemistry	3, 3′	Stainless steel	278.8	36.8	Basement interval, ~8 m below base of packer, center of 5-1/2 inch casing
Microbiology	1, 2	Titanium	281.7	39.7	Basement interval, ~10.6 m below base of lower packer

Notes: Valve ID indicates valve in CORK wellhead. The two microbiology valves in each wellhead are connected to a single sampling line. Geochemical values are also replicated, with two valves monitoring each depth interval. Tubing used for monitoring and sampling terminates in wire-wrapped miniscreens, except for pressure monitoring just below seafloor CORK seal (both CORKs) and dedicated seafloor gauge (Hole U1362B). Depths reported as meters below seafloor (mbsf) and meters subbasement (msb) refer to termination of sampling line. Second pressure values (negative in mbsf column) refer to seafloor monitoring points. NA = not applicable.