Integrated Ocean Drilling Program
Expedition 341S Scientific Prospectus

Simple Cabled Instrument for Measuring Parameters In situ (SCIMPI) and Hole 858G CORK replacement

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Abstract

Integrated Ocean Drilling Program Expedition 341S is an engineering expedition dedicated to two separate projects. One is the first deployment of the Simple Cabled Instrument for Measuring Parameters In situ (SCIMPI) on the Cascadia margin. The second is to replace the CORK in Hole 858G for formation pressure monitoring in the Middle Valley axial rift of the Juan de Fuca Ridge. Both installations are to be incorporated into the NEPTUNE Canada observatory network.

The SCIMPI is a new observatory instrument designed to study dynamic processes in the subseabed based on a simple and low-cost approach. The SCIMPI was developed to provide, when appropriate, an alternative to CORK subseafloor observatories that can be more complex, costly, and time consuming to install. The SCIMPI makes time series measurements of subseafloor temperature, pressure, and electrical resistivity at several depths that can be tailored for site-specific scientific objectives. The SCIMPI's modular design enables custom configuration based on the study goals and the subseafloor characteristics.

The new CORK to be installed in Hole 858G will be constructed with a simplified seal system that has been designed to survive the overpressures and high temperatures at this location. Pressure and temperature data from the refitted hole will complement those from the nearby Hole 857D CORK, which has been in continuous service since 1996, as well as data from seismometers and other instruments that will be part of a multidisciplinary NEPTUNE Canada observatory at this seismically, geodynamically, and hydrothermally active site.

Schedule for Expedition 341S

Operations during Integrated Ocean Drilling Program (IODP) Expedition 341S are dedicated to the first installation of the Simple Cabled Instrument for Measuring Parameters In situ (SCIMPI) in a subseafloor borehole and to the replacement of the CORK in Hole 858G in the Middle Valley rift of the northernmost Juan de Fuca Ridge. The expedition is scheduled for the research vessel *JOIDES Resolution*, operating under contract with the U.S. Implementing Organization (USIO). At the time of publication of this *Scientific Prospectus*, the expedition is scheduled to start in Victoria, Canada, on 20 May 2013 and to end in Victoria, Canada, on 29 May 2013. A total of 9 days are available for the operations required for installing the SCIMPI and CORK replacement as described in this report (for the current detailed schedule, see **iodp.tamu.edu/scienceops/**). Further details about the facilities aboard the *JOIDES Resolution* and the USIO can be found at **www.iodp-usio.org/.**

SCIMPI installation

What is the SCIMPI?

The SCIMPI is a new subseafloor observatory instrument designed for installation in sediments below the seafloor, providing high depth and time resolution measurements of the physical properties in the sediment (Fig. **F1**). It will operate for >2 years on internal batteries that can be replenished via remotely operated vehicle (ROV). It can also be connected to cabled observatory systems for real-time data acquisition. With either periodic battery replacement or connection to cabled observatory infrastructure, the SCIMPI provides long-term observations for understanding subseafloor dynamics, such as changes in seafloor and subseafloor gas hydrate systems. The main advantages of the SCIMPI are the ability to tailor the measurements to the targeted seabed characteristics and its relatively small amount of equipment and installation requirements, making it an economical and versatile system for scientific research.

Configuration of the SCIMPI system and specifications

The SCIMPI is designed for dynamic hydrogeological conditions in which the borehole walls collapse around the device once the drill string through which it is emplaced is withdrawn. Borehole relaxation occurs because of two different processes: slower, creep-dominated deformation in fine-grained clays and shales and immediate collapse in unlithified coarse-dominated sediments.

A SCIMPI string consists of multiple measurement modules and a command module connected by varying lengths of cable with a ballast weight at the bottom of the string (Fig. **F1**). It contains internal batteries but is also able to be powered and controlled via an underwater-mateable connector to either an ROV-replaceable command module or cabled observatory infrastructure. The physical arrangement of modules is serial, but the communications and 9–80 volt direct current (VDC) power busses are multidrop interfaces.

The SCIMPI uses commercial off-the-shelf temperature and pressure sensors that have been successfully used in other marine, industrial, and scientific applications. Individual modules can be tailored to specific measurement missions by configuring the instruments, adding or reducing the instrumentation per module, combining several modules in a single unique casing, or modifying separation between modules by varying cable lengths (Fig. F2). Each sensor module contains a measurement supervisor, a microcontroller for interfacing with as many as four sensors and reporting their data via an RS-485 Mobdus network. A single wire from the logger controls power switching within the sensor modules. The system is optimized to save energy and remain in sleep mode when measurements are not taken. The master controller (MC) is the main processing and data storage component. It consists of a data logger and a supervisor responsible for communications during deployment, communications with sensor modules, and data management for the entire system.

Temperature and pressure in the modules are currently measured using the Seabird SBE-38 and the Paroscientific 410K-101, respectively. These instruments are commonly used in ocean sciences and provide data for characterizing dynamic fluid flow in subseabed environments.

The electrical resistivity smart sensor (ERSS) is custom built as a low-powered four-electrode system that is currently configured for the 0.1–100 Ωm range with alternating polarities at a rate of 100 Hz. This configuration can be adapted for other requirements depending on specific missions. The ERSS does not integrate the correction for temperature in its data output. This should be considered during data analysis in relation to the deployment media. All SCIMPI sensors are manufacturer-calibrated.

SCIMPI modules are powered either by internal battery packs or by connection to a network with an input of 9–80 VDC. The internal battery packs comprise 12 C-sized primary lithium thionyl chloride cells in parallel stacks of four cells in series to provide 26,000 mAh at 14.4 VDC. The batteries are nonrechargeable.

During deployment in a borehole, the SCIMPI will be powered up via the logging wireline cable until release, when the system will automatically shift into recording mode and use the internal batteries. If the SCIMPI is connected to a network, the network acts like the wireline cable, enabling more frequent logging and overriding the internal battery power.

The SCIMPI is configured via a Windows personal computer application (SCIMPI Config) provided by Transcendev (**www.transcendev.com/**). The configuration is adapted for specific applications by adjusting the rate of measurement for each instrument. Data output of the instrument is recorded in a Universal Time Coordinated time-stamped ASCII file.

This first SCIMPI is designed for a maximum water depth of 1300 m and maximum subseafloor depth of 300 m. However, the system can be adapted to monitor in greater water depths (as much as 6000 m) and subseafloor depths.

Although this first SCIMPI is configured to measure temperature, electrical resistivity, and pressure, the SCIMPI is designed so that it is capable of incorporating other types of sensors.

Where are we installing the SCIMPI?

Why Cascadia?

The Cascadia margin is an ideal location for SCIMPI deployment, as it is in a dynamic hydrate formation environment where a cabled ocean observatory infrastructure (NEPTUNE Canada; **www.neptunecanada.com/**) is readily available.

The installation of this system in close proximity to preexisting boreholes and CORK observatories (1) enhances our ability to successfully install the SCIMPI, (2) will provide essential information to evaluate the feasibility of the SCIMPI, and (3) is in a location of active gas hydrate research.

Figures **F3** and **F4** show the location of the proposed SCIMPI installation sites in relation to the features mentioned above.

General science of Cascadia margin gas hydrates and SCIMPI site locations

The northern Cascadia margin is an ideal location for the study of the occurrences and formation of gas hydrate. One of the SCIMPI's primary applications is to observe changes in subseafloor hydrate formations. The sites proposed are those not only where gas hydrate occurs, but also where venting from the seafloor into the water column occurs.

The proposed site and alternate sites are located in a vent area called Bullseye Vent (Fig. **F5**). This area has been previously drilled during the Ocean Drilling Program (ODP) (Leg 146, Site 889/890) and IODP (Expedition 311, Sites U1327 and U1328).

Bullseye Vent is the most prominent vent within a seafloor cold vent field ~8 km^2 in size. Bullseye Vent has been the subject of many geophysical and geochemical studies (e.g., Riedel et al., 2006a, 2006b).

The primary site proposed for the SCIMPI installation, Site CAS05-CORK, is shown in Figure F6. It is northeast of Bullseye Vent in an area known for vigorous degassing. Installation of the SCIMPI at Site CAS05-CORK will contribute to understanding fluid flux and how it changes during both seismic and aseismic events.

We also include two alternate sites locations: Sites CAS10 and CAS11.

Alternate Site CAS10 (Fig. F7) is located at the northern end of the Bullseye Vent seafloor depression feature where massive gas hydrates occur in addition to a strong bottom-simulating reflector (BSR) (Fig. F8). Site CAS-10 is located less than ~100 m north of the main Site U1328 where logging-while-drilling (LWD) data were obtained.

Alternate Site CAS11 is located northwest of the Bullseye Vent area (Fig. F9) near Site 889 and IODP Expedition 328 Advanced CORK Site U1364. Site CAS11 is at the frontal portion of the Cascadia accretionary prism (Fig. F10) where SCIMPI results could be directly compared with ACORK measurements. The position of these observatories will allow for monitoring pressure gradients associated with subduction-driven consolidation, gas hydrate dynamics, and responses of hydrates to seismic ground motion.

SCIMPI observatory configuration

The nine SCIMPI modules will be configured to maximize capture of dynamic processes at specific depth intervals. The likely configuration is shown in Figure F11 and listed in Table T1. The location of sensor modules was determined applying a k-means cluster analysis to previous IODP core and logging data near Site CAS05-CORK (Lado Insua et al., 2012). This analysis provides an unbiased identification of the major formations characteristics, identifying depths with similar characteristics as the same cluster.

SCIMPI operations plan/drilling strategy

The primary operational objective is to drill a hole to 300 meters below seafloor (mbsf) and install a SCIMPI observatory system. Planned operational steps and time estimates are provided in Table T2.

The preferred location for this installation is at proposed Site CAS05-CORK in the vicinity of Bullseye Vent. This proposed site is ~400 m from Site U1328, which was drilled with LWD and cored to a total depth of 300 mbsf.

The ship will be positioned over the site location coordinates, thrusters and hydrophones will be lowered, and a positioning beacon will be deployed (if considered necessary). A bottom-hole assembly (BHA) will be made up with a 9⅞ inch outer diameter tricone bit and a mechanical bit release (no coring will be conducted). The BHA will be tripped to the seafloor, the top drive will be picked up, and the drill string will be spaced out for spudding the hole. During the pipe trip, all drill collars and pipe stands will be drifted to verify minimum interior diameter of the entire drill string. In addition, the subsea camera system will be deployed to provide a visual verification of the seafloor depth when the drill bit tags the mudline. After recovering the subsea camera, the hole will be spudded and controlled drilling will be used to advance hole to 300 mbsf. The objective will be to maintain a good quality hole for the SCIMPI installation. Washouts due to excessive circulation should be minimized.

After completing the hole to total depth, it will be flushed of all cuttings and a wait period will be conducted to provide feedback on hole stability. The bit will be picked up ~10 m off bottom and ~4 h will spent with the pipe and BHA suspended in the hole without any circulation or rotation—this is intended to mimic the conditions and length of time for SCIMPI assembly and installation. At the end of this period, the drillers will attempt to recover the drill string to ~80 mbsf without rotation or circulation. If this goes well, confidence will be high that the SCIMPI installation can proceed as planned. If the pipe has become stuck and must be worked free, then upon doing so, a full wiper trip using circulation and rotation will be conducted to restore the hole condition to as optimal as possible. Once back on bottom, the hole will be displaced with 10.5 ppg weighted mud, and (time permitting) the wait process will be repeated. It should be noted that the desire is to not fill the hole with heavy mud if it can be avoided, as this could interfere with some of the SCIMPI sensors.

Based upon the results of the aforementioned actions, there are two possibilities for SCIMPI emplacement. The drill bit could be released at the bottom of the hole and end of pipe (EOP) placed at ~80 mbsf. The alternative is to release the drill bit at the bottom of the hole and leave the EOP ~10 m off bottom. Which approach has the highest chance of success will be the subject of shipboard discussions once the hole has been drilled and potential long-term stability has been ascertained.

The SCIMPI assembly, having been preassembled and prepared for deployment, will then be picked up using Yale grips and multiple rig floor tuggers. Once suspended within the drill string, the upper SCIMPI connection will be made up to the Schlumberger cablehead, which in turn is connected to the Multifunction Telemetry Module

(MFTM) and then the electronic release system (ERS; also referred to as the electronic RS overshot) on the lower end of the electric logging line. The SCIMPI assembly will then be lowered through the drill string and either into the open hole or to the bottom of the drill string, depending upon the approach chosen above. The MFTM will be used to confirm that all SCIMPI modules are in working order. After everything checks out, the MFTM surface panel will be used to actuate the ERS to release the SCIMPI. The logging line will be recovered and the drill string will then be pulled out of the hole, leaving the SCIMPI assembly in the borehole. Care will be taken when clearing the seafloor to ensure that the ship is positioned over the hole coordinates to minimize BHA swing once clear of the seafloor. The subsea camera system will be used to observe the BHA being raised out of the seafloor and over the top of the SCIMPI installation. About 20 m of the SCIMPI installation will extend above the seafloor for later access by ROV or submersible (underwater-mateable connector, cable, floats, data logger, etc.). A short camera survey of the resulting SCIMPI installation will be conducted before retrieving the drill string.

SCIMPI risks and contingency

Failure of tool during deployment

As part of the SCIMPI project, the primary tool components have all been bench tested, wet tested, and pressure tested. Subsequent to these tests, some modifications have been made to the ERS. Because of this, we plan to repeat the bench test before the expedition. Before deployment on the ship, the SCIMPI will be assembled and tested in the laboratory. The design of the ERS-SCIMPI system allows for real-time communications via the wireline, so we can monitor SCIMPI's functionality during deployment on the rig floor, while lowering into the borehole, and through final release. We also anticipate sailing the primary engineers responsible for development of the various critical communications components.

Hang up of SCIMPI array prior to arrival at depth

The SCIMPI was limited to a 3 inch maximum diameter with no abrupt diametrical changes to minimize this possibility. Although we do have drill bits that could allow SCIMPI to pass, we plan to drop the drill bit before deploying SCIMPI to provide the maximum opening possible. To minimize the chances that SCIMPI might hang up while being lowered through the open hole, we have the option to deploy the SCIMPI with the BHA near the bottom of the hole. Finally, the real-time monitoring capability of the SCIMPI pressure sensors will provide a proxy for depth, and the SCIMPI can be retrieved before release if it is too shallow because of hole collapse or other problems.

Hole stability

This SCIMPI installation is located near existing drill sites so that we can take advantage of previous drilling and formation information. Drilling operations will include routine techniques for improving borehole stability to prevent the drill pipe from becoming stuck and for enhancing successful SCIMPI installation. In response to the risk that the BHA could become stuck during SCIMPI assembly and deployment, we have inserted a hole stability test in the planned operations. If necessary, wiper trips and heavy mud will be used.

Drill string motion after release

The sea state during final installation, release, and drill pipe withdrawal will be critical. We want to reduce the possibility that the drill string might sever the SCIMPI cable or damage the data module as the ship heaves within the hole and near the seafloor. We do not anticipate using a seafloor structure because we believe this could increase the risk of severing/damaging the SCIMPI. The time to withdraw the drill string out of the seafloor and over the SCIMPI should be minimized, while also ensuring we don't pull the SCIMPI out of the hole. We will have the subsea camera system deployed while pulling out of the hole. However, only when the very last part of the BHA—the EOP—exits the borehole at the seafloor will we know if the SCIMPI stayed in the hole as planned along with the appropriate extension above the seafloor to allow postexpedition ROV access.

Release mechanism

Based on recommendations from Expedition 342 scientists, a newly redesigned ERS will be used to release the SCIMPI. The ERS has a snap-lock that is latched at the surface to the top of the SCIMPI, and the entire assembly is then lowered into the borehole. An electric motor within the ERS is commanded from the MFTM surface panel to rotate until the RS pulling neck on the SCIMPI is released. This motor can both unlock the ERS from a downhole tool and return the ERS to a locked position so that it can be used to retrieve a downhole tool. The ERS consists of an electronics section, wired through sinker bars, and a motor section that contains the latching mechanism at the bottom of the tool. The MFTM is a downhole sonde that allows real-time communication with the SCIMPI modules through the Schlumberger armored seven conductor cable. It will be used to capture data streams from the different SCIMPI modules before the entire assembly is released and to activate the latching mechanism of the ERS.

Weather/Sea state

The expedition has been scheduled during one of the optimum weather windows for this region. If on-site conditions are too severe to operate (e.g., heave, unsafe rig floor conditions, etc.), the limited contingency time (12 h) will be used to wait for conditions to improve. If offshore conditions are entirely unsuitable for operations, there are currently approved alternate locations to install the SCIMPI.

Hole 858G CORK replacement

Background

As part of Expedition 341S, we plan to re-instrument Hole 858G in the sediment-filled Middle Valley axial rift of the northernmost Juan de Fuca Ridge for long-term hydrologic monitoring. This hole and its companion Hole 857D (Fig. **F12**) were equipped with the first CORK hydrologic observatories in 1991 during ODP Leg 139 (Davis et al., 1992) to determine the thermal and hydrologic state within the buried permeable igneous crust of the valley and the driving forces for fluid flow through the seafloor in the vent field where Hole 858G is situated. For reasons not fully understood at the time, the CORK seals of Hole 858G failed after roughly 1.4 y, after which only hydrostatic (seafloor) pressure was recorded by the formation sensor (Fig. **F13**). This CORK and the one in Hole 857D were replaced during a second phase of drilling in the area, ODP Leg 169. The latter remains operational and the 16 y continuous record of seafloor and formation pressure has provided information well beyond the scope originally anticipated for the experiment. Unfortunately, the Hole 858G CORK failed again, this time in roughly 1 y. Inspection of the failed seals and mineral deposits within the original CORK recovered during Leg 169 suggested that the seals had suffered from exposure to high-temperature formation fluids, although this factor alone cannot have been responsible. Natural formation temperatures at this location do not reach the ~270°C temperature of the Middle Valley hydrothermal system until a depth of roughly 80 mbsf. Temperature at the level of the CORK seals situated only ~1 mbsf should have been close to the bottom water temperature. Failure of some component within the CORK body may have caused the initial leakage, leading to increased temperatures, chemical imbrittlement, and ultimate failure of the main CORK seals (see discussion in Fouquet et al., 1998).

Despite these problems, the data collected prior to seal failure provided a valuable complement to those from the CORK in Hole 857D. They provided an approximate lower limit on the formation pressure available to drive flow from the igneous crustal hydrothermal reservoir vertically through seafloor vents, and they provided an estimate for the differential pressure available to drive flow within the sediment-sealed permeable reservoir (e.g., Davis and Becker, 1994).

Motivation for revitalizing the Hole 858G CORK

Since the time that the monitoring experiments were originally undertaken, several factors have accumulated to lead us to the current project:

1. From a scientific perspective, long-term monitoring experiments at a number of sites in tectonically active settings (Juan de Fuca Ridge axis and flank, Mariana forearc, Costa Rica prism, and Nankai accretionary prism) have revealed that formation fluid pressure variations provide a sensitive proxy for volumetric strain. Transient events related to coseismic, postseismic, and aseismic deformation have been seen at all of these locations, and observations are leading to new understanding about the episodic nature of deformation, seismic energy efficiency, and regional interseismic strain accumulation. Some of the best examples come from Middle Valley Hole 857D, which has provided an unprecedented look at seismotectonic processes at ridge axes by virtue of its location, the local sensitivity of pressure to strain, and the very long continuous record of pressure (Fig. **F14**). One example contained in this record shows very clearly how formation pressure responds to coseismic elastic strain produced by three earthquakes, postseismic slip, and hydrologic readjustment (Fig. **F15**). Pressure transients like this are numerous through the history of recording at Hole 857D. They reflect strain generated by slip on faults within Middle Valley (as in Fig. **F15**) and in the surrounding region, specifically the neighboring West Valley rift, the Endeavour axial segment to the south, and the Nootka Fault to the northeast. We anticipate that future events captured at both Holes 857D and 858G will provide new insights into the complex mixture of hydrologic and viscoelastic response to fault rupture and allow them to be separated. Data from one hole by itself makes this separation equivocal, so the combination of data from Holes 857D and 858G will be invaluable.
2. From a technical perspective, a number of things fortify the justification for revitalizing this hole. High reliability of CORK instrumentation has been demonstrated through successful long-term operations at many sites. Instruments

deployed during Leg 196 (Nankai) have been operating continuously since their deployment in 2001 (Mikada, Becker, Moore, Klaus, et al., 2002; Davis et al., 2009, submitted), those in the Middle America subduction zone off Costa Rica since 2002 (Morris, Villinger, and Klaus [Eds.], 2006; Davis and Villinger, 2006; Davis et al., 2011), and the one in Hole 857D deployed during Leg 169 since 1996 (Fouquet, Zierenberg, Miller, et al., 1998; Davis et al., 2006; Hooft et al., 2010; Inderbitzen, 2013). Improvements in power consumption, memory capacity, and resolution now permit detection of much more subtle signals. And in this instance, connection to the NEPTUNE observatory cable infrastructure will open up great opportunities. Much higher sampling frequency can be achieved, allowing observations to reach into the seismic frequency band, and the observations can be placed in context of co-located seismic and hydrologic records that will be collected at this NEPTUNE node with a broadband seismometer and a variety of seafloor vent monitoring instruments.

3. From a financial perspective, setting up existing holes like 858G for long-term monitoring in a time-efficient and economical way makes good sense, as it takes advantage of existing infrastructure like NEPTUNE, which will minimize the need for costly and time consuming site visits using a ship and submersible or ROV.

Hole 858G CORK replacement operations plan/drilling strategy

A scheme is proposed by which pressure monitoring can be re-established and later access can be gained to the interior of the borehole. The operations plan is presented in Table **T2** and consists of two main operational steps:

1. Removing the existing CORK body and 370 m long thermistor string. This would be done with the existing ODP CORK retrieval tool and would require a single pipe trip. A comparable operation was recently carried out in Hole 395A during IODP Expedition 336, with the data logger and thermistor cable removed and sampled for microbiology when the CORK body reached the rig floor. The thermistor string in Hole 858G cannot be reused and so would also be available for sampling for microbiology. Expedition 336 recovery operations are bound to provide an incomplete analogy for the 858G CORK recovery, however. Recovery of the original CORK during Leg 169, 5 y after its installation, was made challenging by the accumulation of hydrothermal mineral deposits within the CORK body and by corrosion of some of the CORK structural components, including those providing a connection to the latch/unlatch mechanism. Given that >16

y have passed since the second CORK was installed, similar challenges and risks of failure can certainly be expected.

2. Installing the new seal stack and instrument. This step will follow a pipe trip to clean the hole of any hydraulically resistive mineral deposits precipitated inside the 11¾ inch casing from water ascending the hole over the history of leakage. The seal stack (Fig. **F16**) will comprise, from bottom up, (a) three joints of drill collars, adding up to a weight (~10,600 lb in water) that will overcome the piston force imposed by the formation overpressure on the seals (roughly 2700 lb); (b) multiple cup seals to land inside the top of the 11¾ inch casing below the casing hanger; (c) landing webs to support the stack in the reentry cone/casing hanger; and (d) a section of reinforced 7 inch casing that would support the instrument package at a convenient position for submersible operations. The top of the stack would mate with one of the standard IODP CORK running tools and would include a removable axial plug for possible future downhole access. Valved plumbing and ports will provide for pressure monitoring and fluid sampling. An instrument package, connected to the hydraulic access line via a pressure-balanced connector and a three-way valve, will contain a current-generation high-precision pressure recorder capable of resolving pressure to roughly 10 parts per billion at 1 Hz sampling frequency and a wellhead temperature sensor that has a resolution of the order of ~0.1 mK. The instrument package will be equipped with batteries to run in autonomous low-sampling-rate mode (15–60 s sampling interval) for a total of roughly 15 y, to facilitate initial autonomous (pre-NEPTUNE connection) monitoring and back-up operations during cable-power downtime. When cable-connected, the instrument will automatically switch into continuous 1 Hz sampling mode, with time-stamped pressure and temperature data passed to the cable via an RS422 serial port. Like others deployed during CORK drilling legs since 2001, the package is designed to be removed and replaced easily by submersible or ROV, augmented with an external battery supply, or connected to a communications cable. Changing position of the three-way valve allows the instrument to be removed while the formation remains sealed, as well as periodic calibration of the formation pressure sensor.

Hole 858G CORK replacement risks and contingency

As mentioned above, there are some inherent risks to the removal of the existing Hole 858G CORK and installation of a new CORK. These are as follows:

1. Engagement of the CORK pulling tool may prove difficult or impossible depending upon sea state at the time of the attempted recovery.

   Mitigation: Stand-by until weather/sea state improves.

2. Once the existing CORK has been engaged with the CORK pulling tool, the CORK latching mechanism may not release properly. History has shown that over time the functionality of this type of latch can become compromised by corrosion and wasting of the metal latch rods.

   Mitigation: Use brute force of drill string overpull to remove existing CORK.

3. When recovering the existing CORK, parts of it might be left in the hole. This could prevent installation of the replacement CORK.

   Mitigation: Use drill string to fish out, push down, or move aside whatever might be blocking the throat of the reentry cone/casing.

4. After removing the existing CORK, the seal surface may be corroded or built up with mineral deposits or sea life. If so, the replacement CORK may not properly seal inside the casing.

   Mitigation 1: See description of "seal stack" above.

   Mitigation 2: Investigate purchase and/or fabrication of a clean-out sub for the bottom of the drill string during the depth check pipe trip.

   Mitigation 3: Investigate possible fabrication of a "water-jet" sub to be run above clean-out sub that would use circulation water/pump pressure to "blast" clean the internal diameter of the casing at the level of the seals.

5. Weather could deteriorate after removal of existing CORK and prevent installation of the replacement CORK. The hole may have to be left open.

   Mitigation 1: Stand by until sea state improves or time runs out.

   Mitigation 2: If hole must be left sealed, the only option would be to seal with cement.

6. Retrieving the existing CORK may take all the time available. No additional time is available. If so, the hole may have to be left open, or if time available and scientifically sensible, the hole could be sealed with cement.

Sampling and data sharing strategy

The supporting site survey data for Expedition 341S are archived at the **IODP Site Survey Data Bank.** No coring or downhole logging is currently planned for Expedition 341S.

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Table T1. Planned depths of SCIMPI sensor modules for Site CAS05-CORK based on k-means cluster analysis of core and logging data, Expedition 341S.

Sensor module number	Depth below seafloor (mbsf)	Cable length above (m)	Cluster number
1	10	10	0
2	55	44	1
3	61	5	1
4	72	10	2
5	105.5	32.5	2
6	126.5	20	1
7	163	35.5	2
8	227	63	3
9	237	9	3

Table T2. Operations plan and time estimate for Expedition 341S (SCIMPI). (Continued on next two pages.)

Description of Operations	Time (hours)	Time (days)
Port Call - Victoria	0.00	0.0
Transit from Victoria, BC, to Hole 858G	21.1	0.9
Site: Hole 858G Water depth: 2417 mbsl, 48° 27.360’N, 128°42.531’W		
CORK Retrieval		
Position over location	1.00	0.0
Remove and layout upper guide horn	1.00	0.0
Pick-up and make-up CORK pulling tool	0.50	0.0
Install mousehole/assemble stabber	0.75	0.0
Pick-up drill collar stand, make up to CORK pulling tool	0.50	0.0
Pick-up drill collars	1.50	0.1
Handle bottom-hole assembly	1.00	0.0
Trip surface to mudline	4.25	0.2
Pick-up top drive	0.50	0.0
Deploy camera system	1.25	0.1
Space out for CORK retrieval	0.50	0.0
Position ship for latching on CORK	2.00	0.1
Verify CORK engagement, pick-up with 10,000 lb	2.00	0.1
Set back top drive	0.50	0.0
Layout knobbies/drill pipe and space out	0.25	0.0
Unlatch CORK/pull free from casing	2.00	0.1
Trip mudline to surface	4.25	0.2
Handle bottom-hole assembly	1.00	0.0
Remove remotely operated vehicle (ROV) platform in moonpool	1.50	0.1
Remove CORK recovery tool	1.50	0.1
Retrieve data logger at surface	2.00	0.1
Layout 858G CORK and stinger	2.00	0.1
Depth check, clean out casing		
Handle bottom-hole assembly	2.00	0.1
Handle camera system	0.50	0.0
Trip surface to mudline	4.25	0.2
Space out for re-entry	1.00	0.0
Position ship for reentry	2.00	0.1
Clean out upper casing		
Trip from 0 mbsf to 300 mbsf	1.50	0.1
Wiper trip from 300 to 80 mbsf and back to 300 mbsf	2.25	0.1
Trip 300 mbsf to mudline	0.50	0.0
Trip: mudline to surface	4.25	0.2
Handle bottom-hole assembly	2.00	0.1
Assenble and Install New CORK in Hole 858G		
Make-up stand of 8-1/4" drill collars	1.00	0.0
Make-up CORK head to CORK running tool	1.00	0.0
Make-up CORK head to top 8-1/4" drill collar	0.50	0.0
Install busings at rig floor	0.25	0.0
Pick-up stand of drill collars	0.25	0.0
Handle bottom-hole assembly	1.00	0.0
Trip surface to mudline	4.25	0.2
Handle camera system	0.50	0.0
Space-out for reentry	0.50	0.0
Position for reentry	0.50	0.0
Make-up and deploy instrument string (not planned)	2.00	0.1
Jar off of Top Plug (not planned)	1.00	0.0
Land CORK and set down with 10,000 lbs	0.50	0.0
Recover camera system	1.50	0.1
Handle camera system	0.50	0.0

Table T2 (continued). (Continued on next page.)

Description of Operations	Time (hours)	Time (days)
ROV Platform (optional - time permitting)		
Assemble ROV platform and Lunar Lander	2.00	0.1
Deploy camera system to sea floor	1.75	0.1
Release ROV platform	0.25	0.0
Recover camera system	1.50	0.1
Handle camera system	0.50	0.0
Remove harness and Lunar Lander		
Deploy camera system	1.25	0.1
Inspect ROV platform and CORK		
Release running tool from CORK head	1.00	0.0
Trip mudline to surface	4.25	0.2
Handle camera system	0.50	0.0
Handle bottom-hole assembly	1.00	0.0
Rig down CORK running tool	0.25	0.0
Lay out drill collars	1.50	0.1
Install upper guide horn and secure moonpool	1.50	0.1
Secure for transit	2.00	0.1
Pull thrusters and hydrophones	0.50	0.0
Total time at Hole U858G:	87.00	3.6
Transit from Hole 858G to Site CAS05-CORK	7.25	0.3
Site: CAS05-CORK Water depth: 1257 mbsl, 48° 40.1797'N; 126° 50.8502'W		
Start Hole A:		
Lower Drill String and Prepare to Spud Hole		
Position over location	1.50	0.1
Pick-up drill collars	2.00	0.1
Handle bottom hole assembly	2.00	0.1
Trip surface to mudline in 1279 m of water	2.25	0.1
Drift tubulars/strap (measure) drill pipe in 1279 m of water	2.00	0.1
Deploy camera system	0.50	0.0
Pick-up top drive and space out drill pipe	1.00	0.0
Drill Hole to 300 mbsf		
Spud Hole A		
Recover camera system from seafloor	1.00	0.0
Drill ahead from mudline to 100 mbsf at a rate of 30 m/h	4.25	0.2
Drill ahead from 100 mbsf to 200 mbsf at a rate of 30 m/h	4.25	0.2
Drill ahead from 200 mbsf to 300 mbsf at a rate of 30 m/h	4.25	0.2
Circulation	1.00	0.0
Test Hole Stability/Release Bit		
Shut down rotation & circulation to test hole stability for SCIMPI installation		
Hole stability test	4.00	0.2
Trip w/top drive f/300 mbsf to 50 mbsf at a rate of 4 stands/h	2.25	0.1
Trip w/top drive f/50 mbsf to 300 mbsf at a rate of 4 stands/h	2.25	0.1
Release bit	1.00	0.0
Assemble & Deploy SCIMPI		
Deploy SCIMPI		
Assemble, test, & deploy SCIMPI via electric logging line	4.00	0.2
Release SCIMPI using Electronic Release System (ERS) & recover logging line	1.00	0.0
Deploy camera system to seafloor	0.75	0.0
Trip w/top drive from 300 mbsf to mudline at a rate of 4 stands/h	5.75	0.2
Note - stop short of clearing sea floor and conduct meeting to finalize plan for stripping over floatation package & clearing seafloor		
Observe strip over as bottom hole assembly is pulled clear of sea floor		
Observe/survey completed SCIMPI Installation	1	0.0

Table T2 (continued).

Description of Operations		Time (hours)	Time (days)
Pull Out of Hole & Secure for Transit			
Trip from mudline to surface in 1279 m of water		2.25	0.1
Recover camera system from seafloor		0.5	0.0
Recover and handle bottom hole assembly		2	0.1
Lay out drill collars		2	0.1
Secure for transit		2	0.1
Contingency		12	0.5
		68.75	2.9

Transit ~257 nmi from CAS05-CORK to Victoria, B.C.	24.5	1.0

Total Port Call (days):	0
Total On-Site (days):	6.5
Total Operation (days):	8.7
Total Expedition (days):	8.7

Figure F1. SCIMPI schematic. Modules and cables are represented here. Buoyancy to keep the system stretched out is provided with flotation modules (not shown) clamped to the cable.

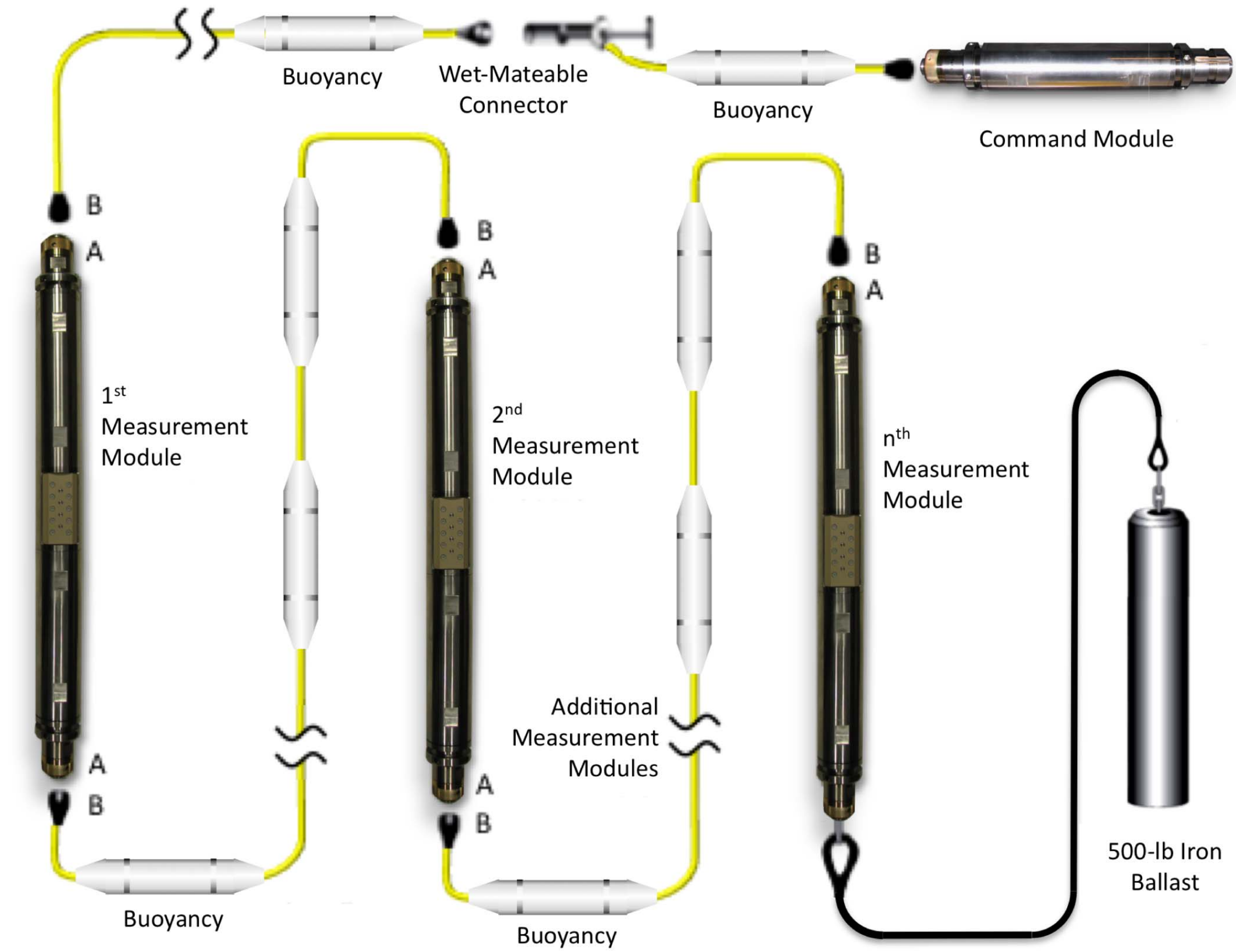


Figure F2. Cutaway view of SCIMPI sensor modules. BCR = bulkhead connector receptacle. **A.** Top: Pressure-Temperature-Resistivity (PTR) measurement module. **B.** Middle: Temperature-Resistivity-Battery (TRB) measurement module. **C.** Bottom: Pressure-Temperature-Resistivity-Battery (PTRB) measurement module.

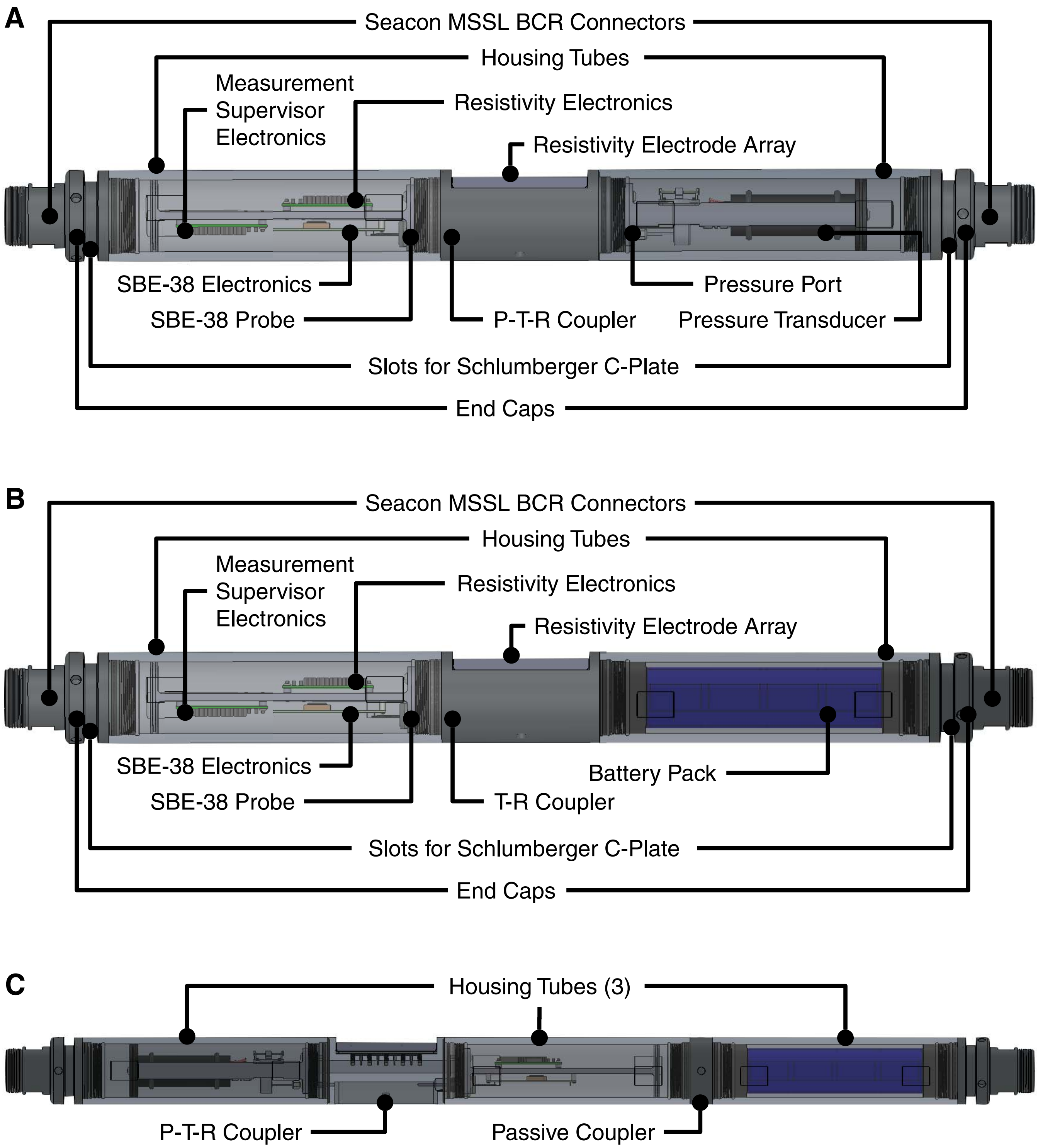


Figure F3. Map of Cascadia margin study location, previous IODP drill sites, and proposed primary (CAS05-CORK) and alternate (CAS10 and CAS11) sites for SCIMPI installation.

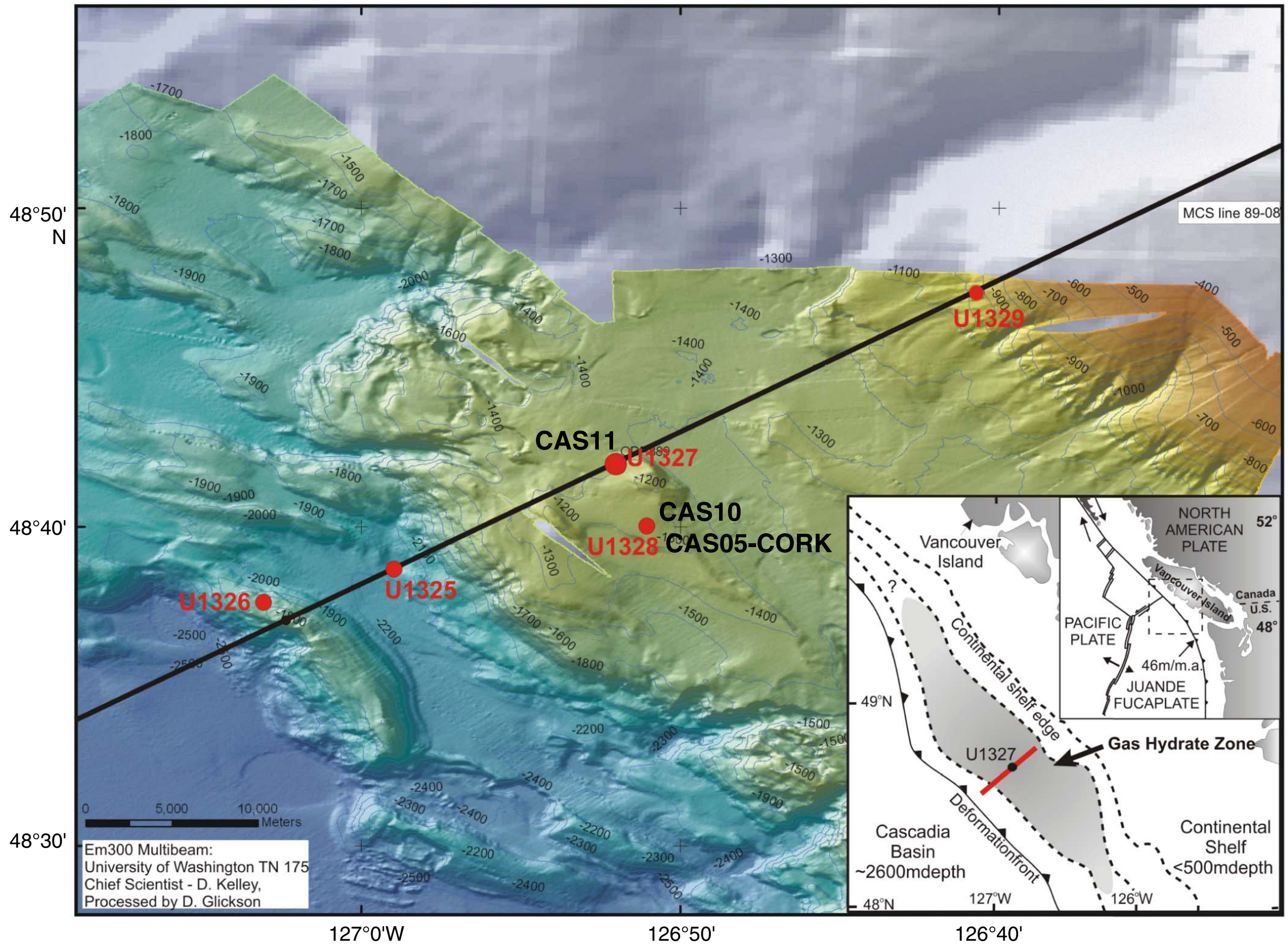


Figure F4. Map showing locations of proposed sites for SCIMPI installation, the NEPTUNE-Canada cable, previous ODP and IODP drill sites, and seafloor venting.

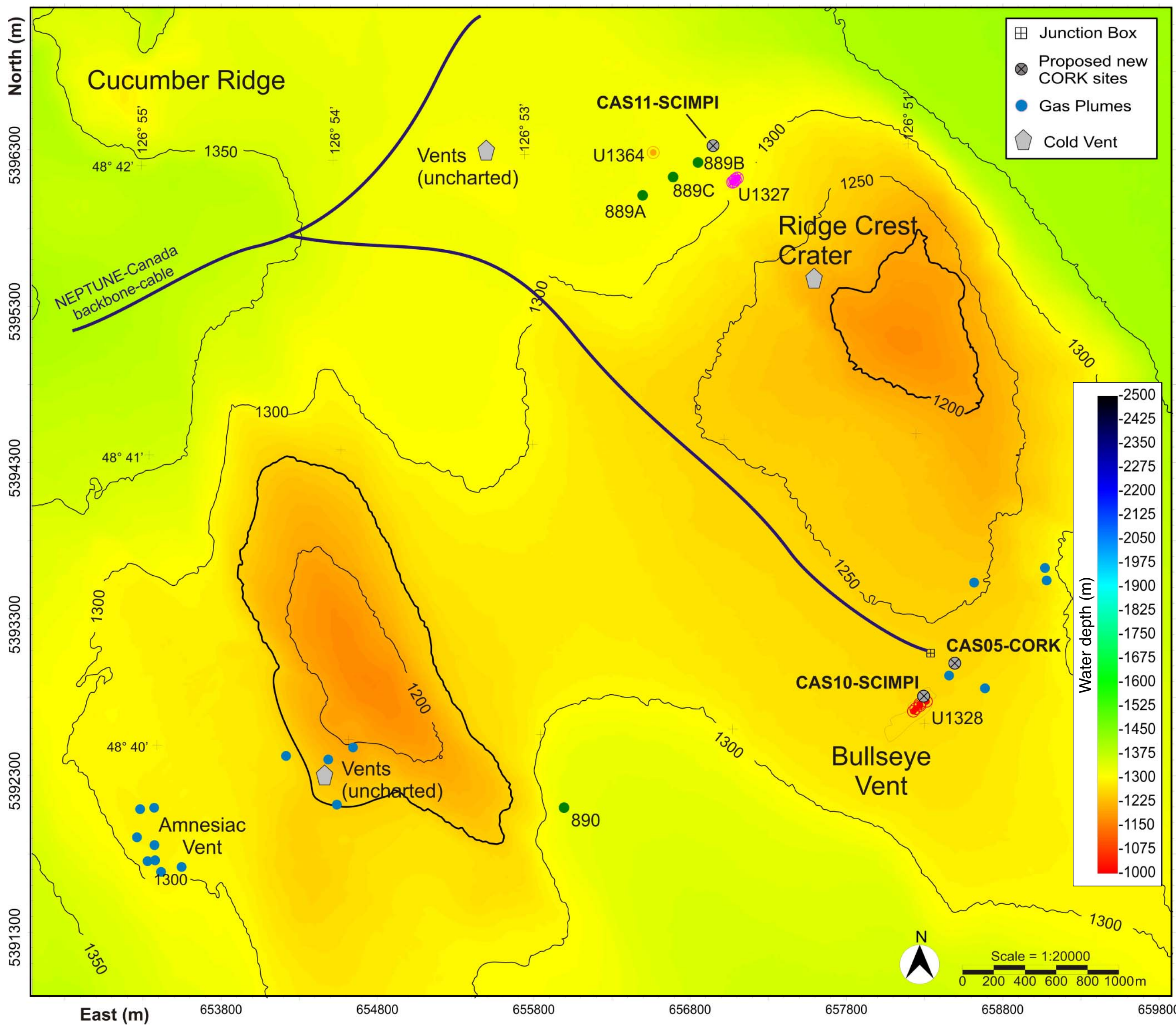


Figure F5. Map showing the location of Bullseye Vent and the locations of the proposed primary site (CAS05-CORK) and alternate site (CAS10-SCIMPI). UTM = universal transverse Mercator projection, BPR = bottom pressure recorder, BBS = broadband seismometer, CSEM = controlled-source electromagnetic cable.

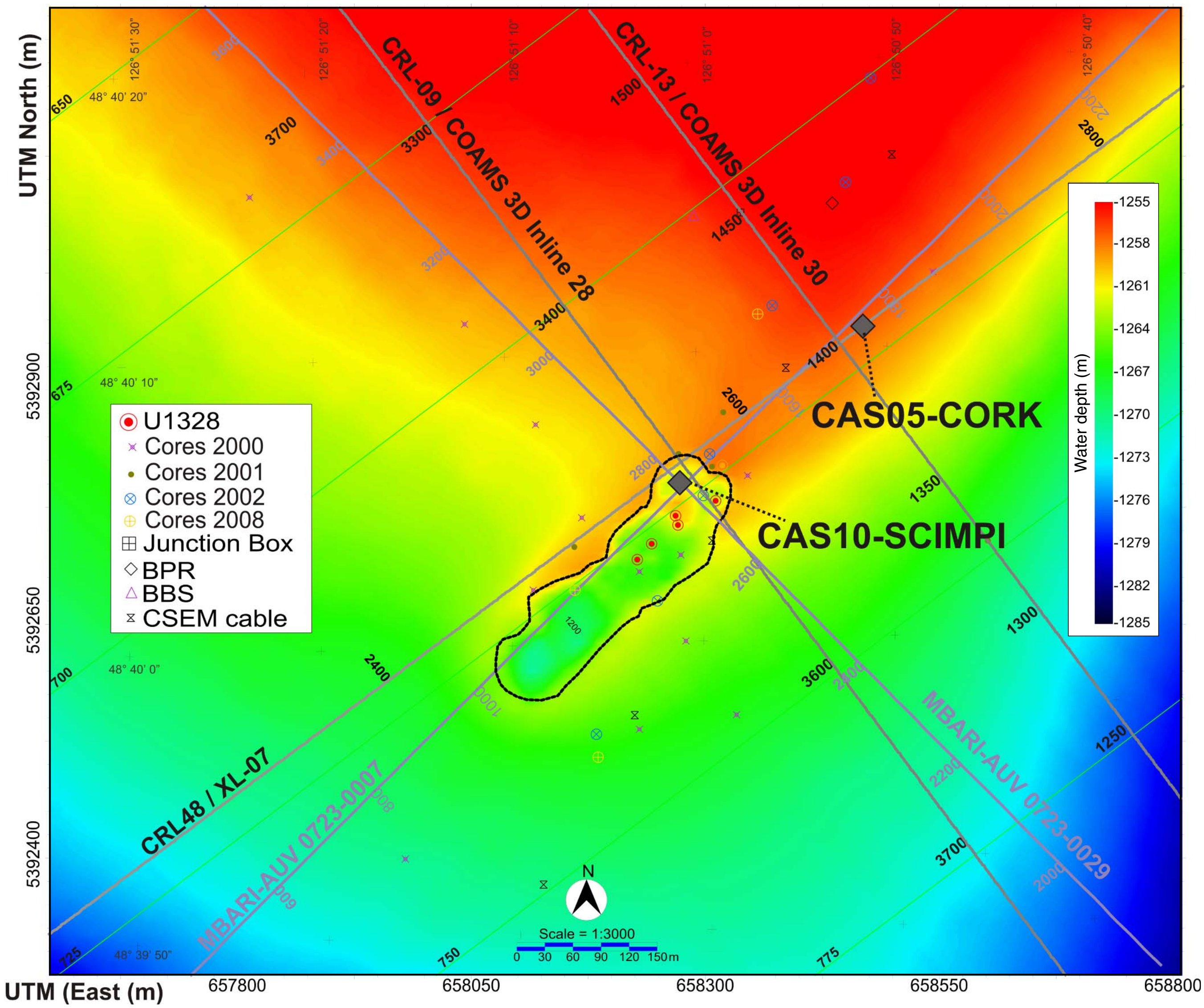


Figure F6. Multichannel seismic line (crl13_inline30) showing the location of Site CAS05-CORK with a well-defined bottom-simulating reflector (BSR). The SCIMPI installation would locate modules above and below the BSR. CDP = common depth point, V.E. = vertical exaggeration.

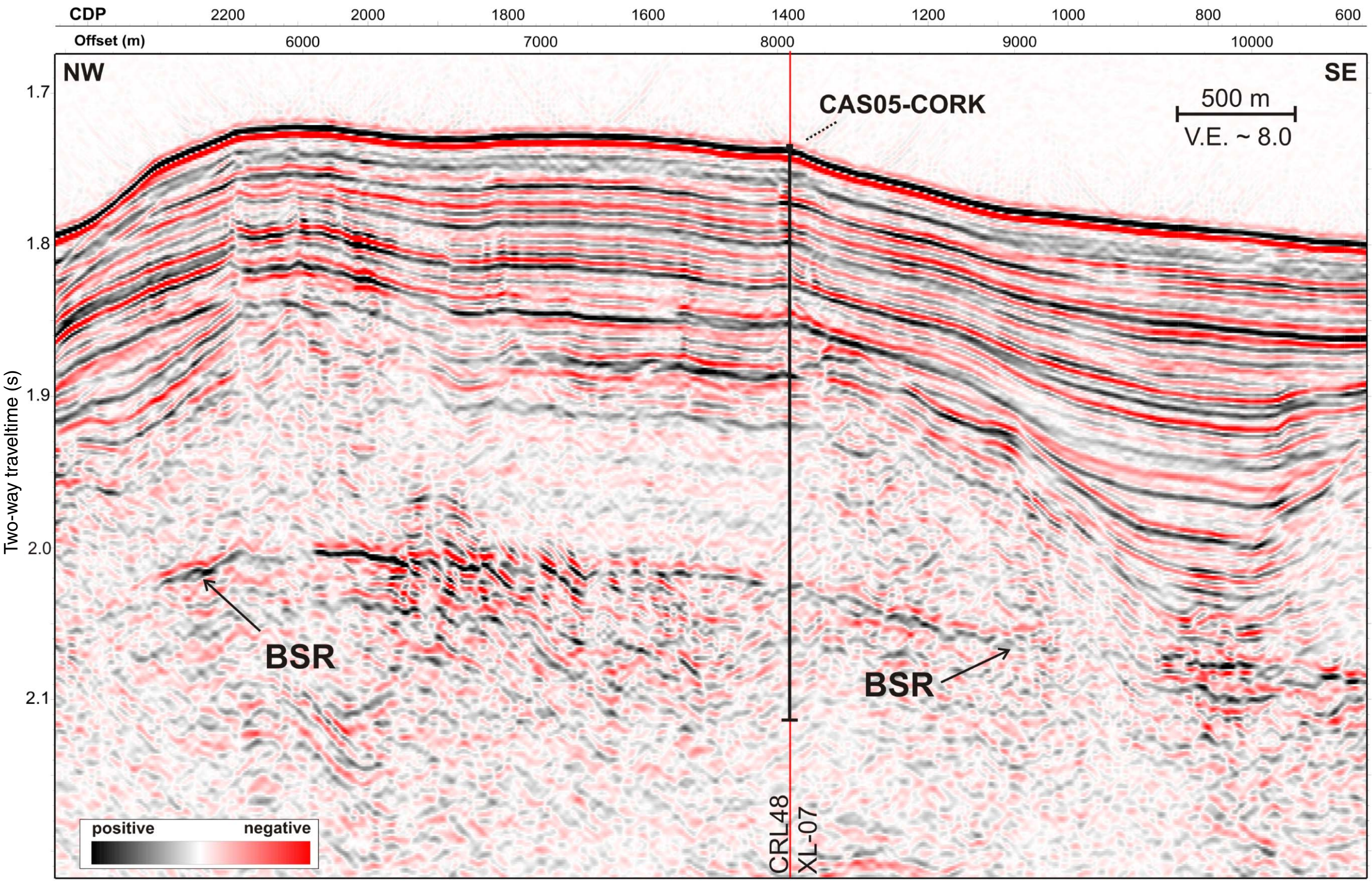


Figure F7. A. Map of Site CAS10 location in the Bullseye Vent system, including holes drilled at Site U1328. **B.** High-resolution seismic reflection data show the hummocky seafloor with multiple small pockmark-like depressions.

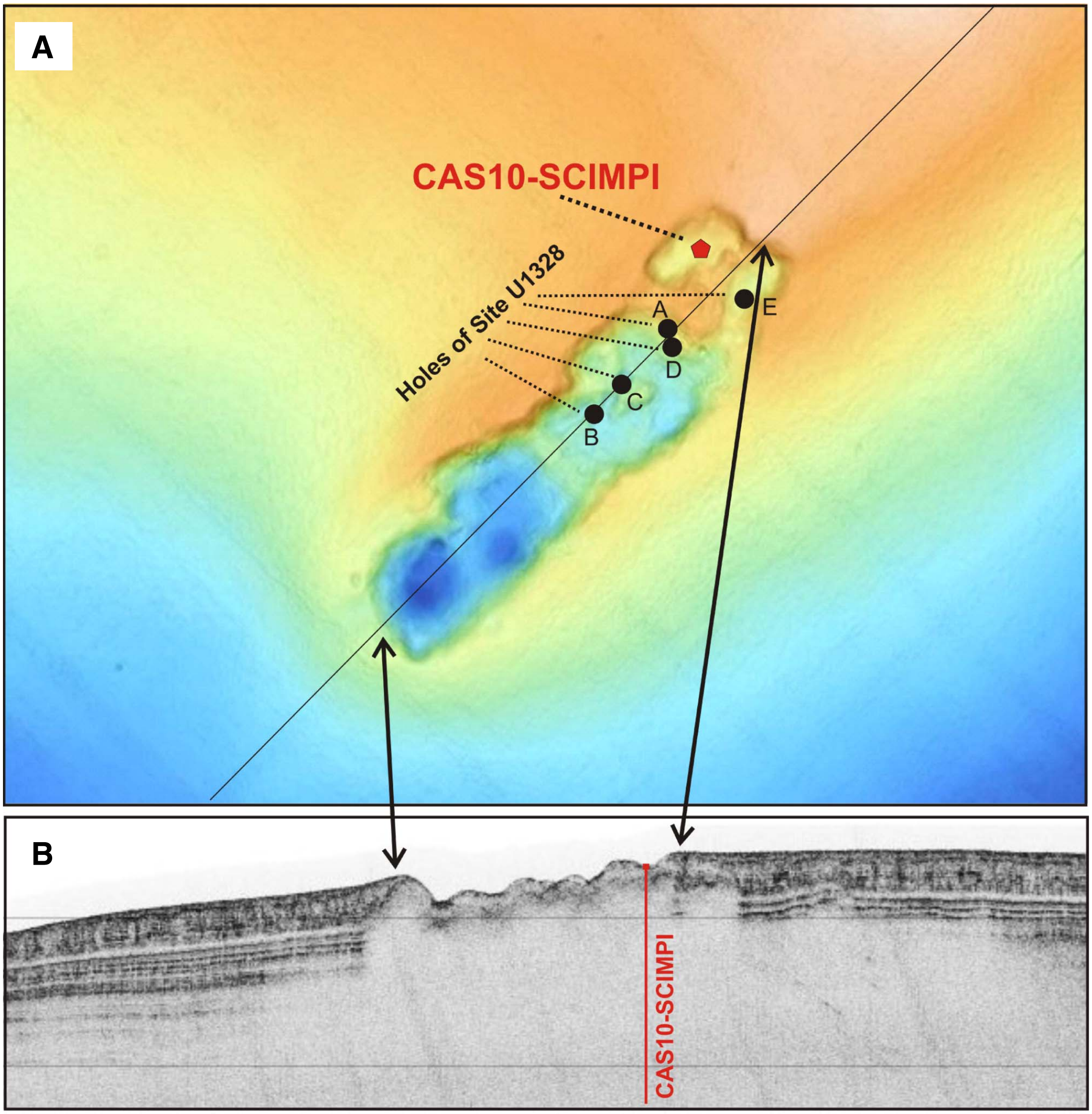


Figure F8. Multichannel seismic data (CRL48-XL07) showing the positions of the primary site (CAS05-CORK) and alternate site (CAS10). Both sites are positioned near the area of a strong bottom-simulating reflector (BSR). CDP = common depth point, V.E. = vertical exaggeration.

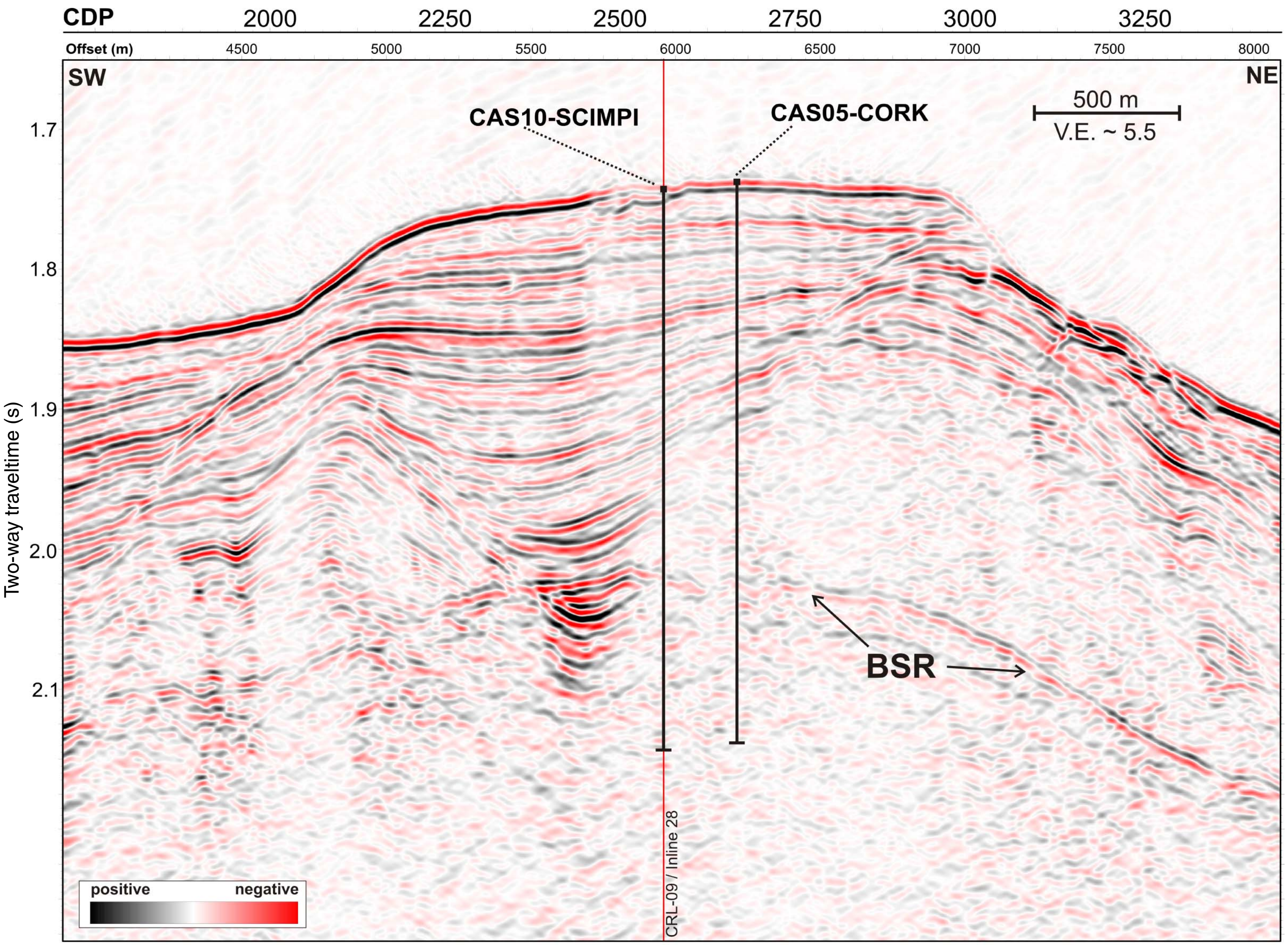


Figure F9. Map of alternate Site CAS11 location (near Sites 889 and 1364) northwest of the Bullseye Vent area where primary Site CAS05 and alternate Site CAS10 are located. WGS = World Geodetic System, UTM = universal transverse Mercator projection.

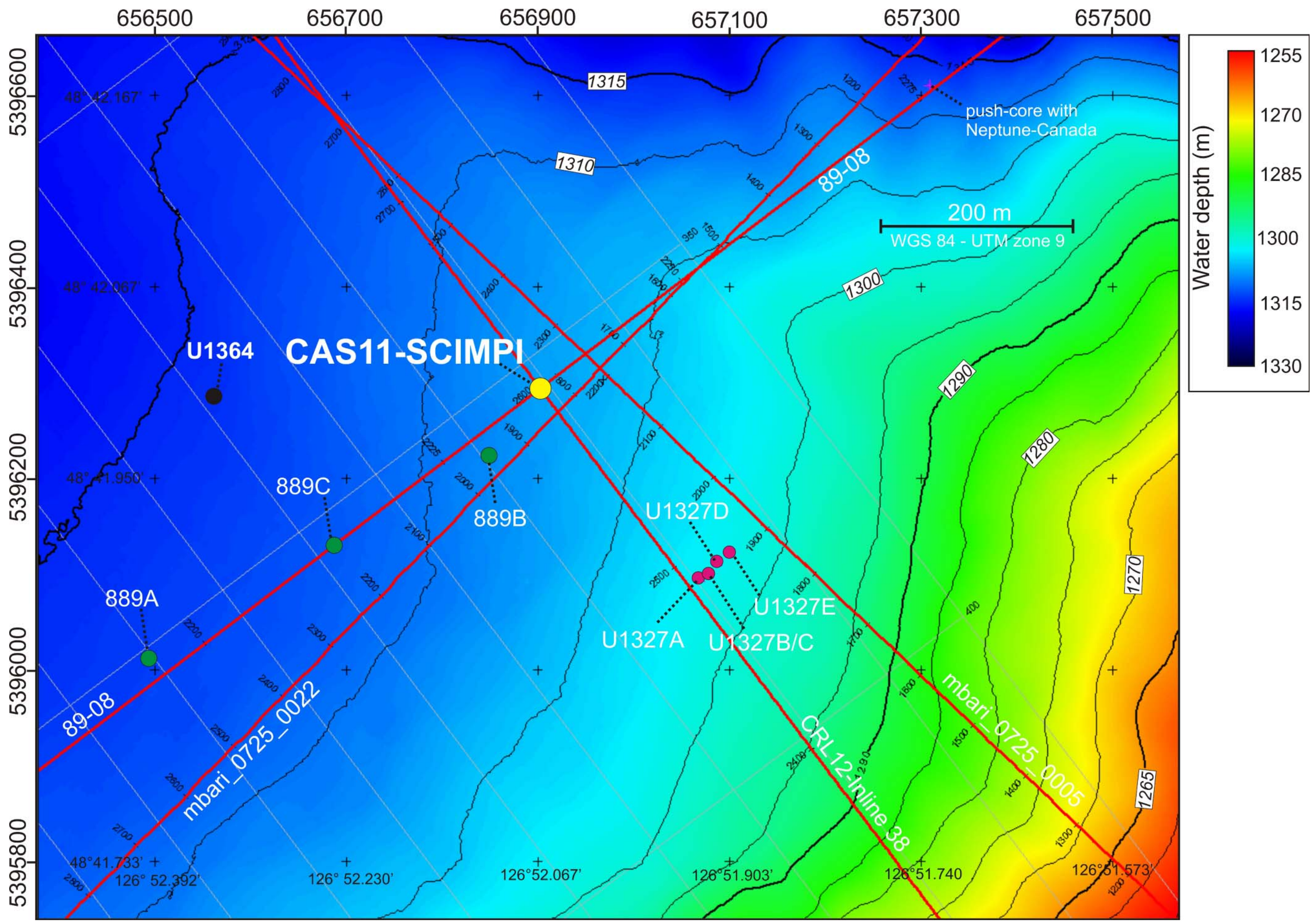


Figure F10. Multichannel seismic data for alternate Site CAS11 and the location of previously drilled ODP and IODP sites. V.E. = vertical exaggeration, BSR = bottom-simulating reflector.

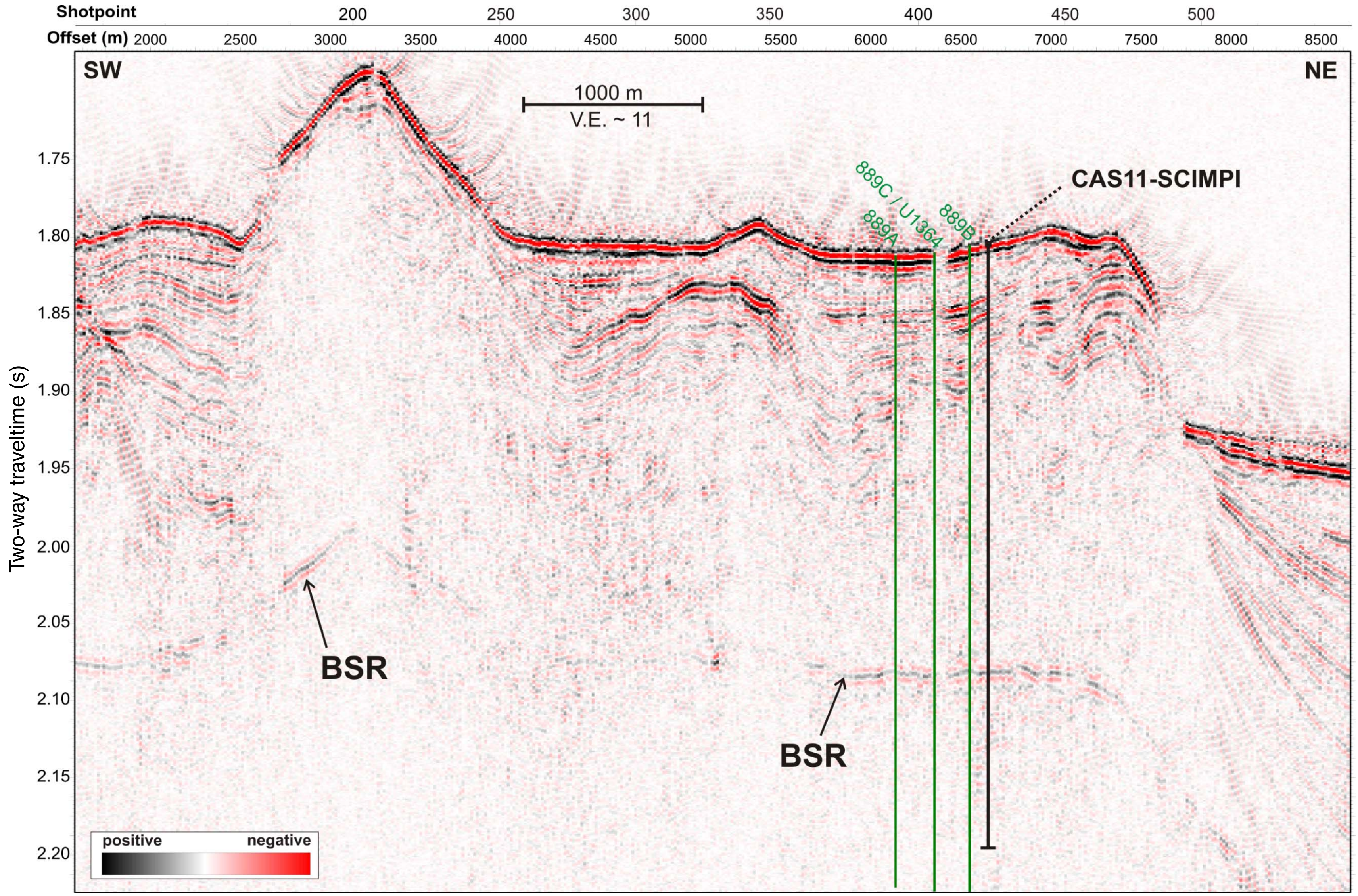


Figure F11. Schematic of SCIMPI module layout for Site CAS05-CORK.

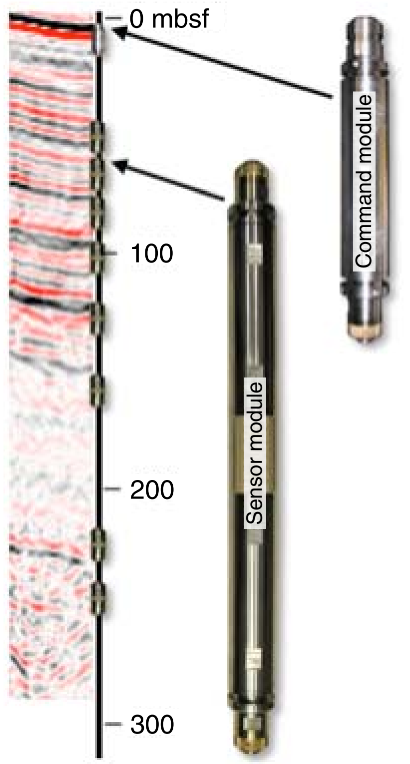


Figure F12. Maps of the sediment-filled Middle Valley rift of the northernmost Juan de Fuca Ridge, showing ODP observatory holes and NEPTUNE Canada infrastructure.

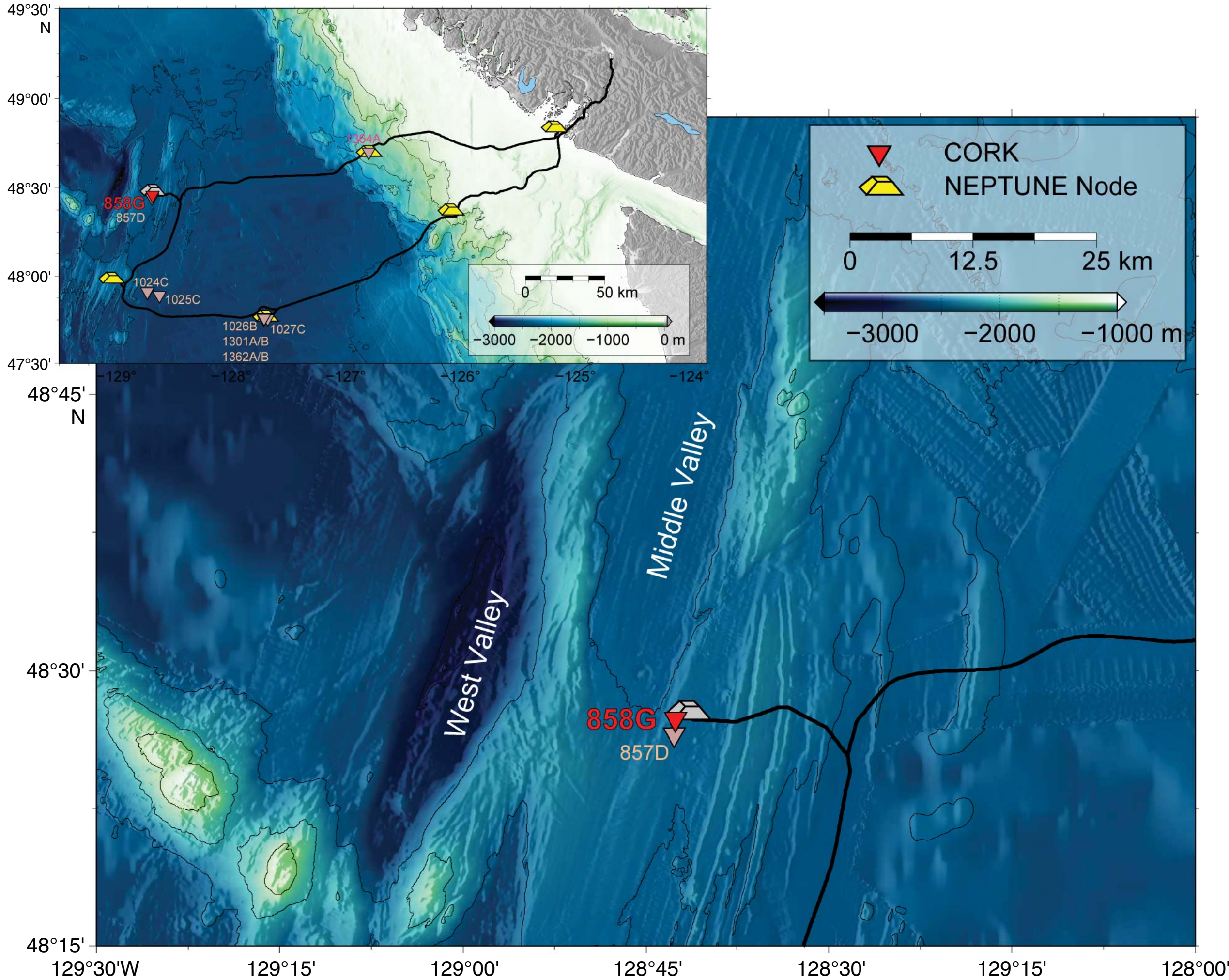


Figure F13. Early histories of pressure recording in Holes 857D and 858G following CORK installations during ODP Legs 139 and 169. Raw data are shown in blue and red; 1 day averaged data and seafloor hydrostatic pressures are shown in black for Hole 858G.

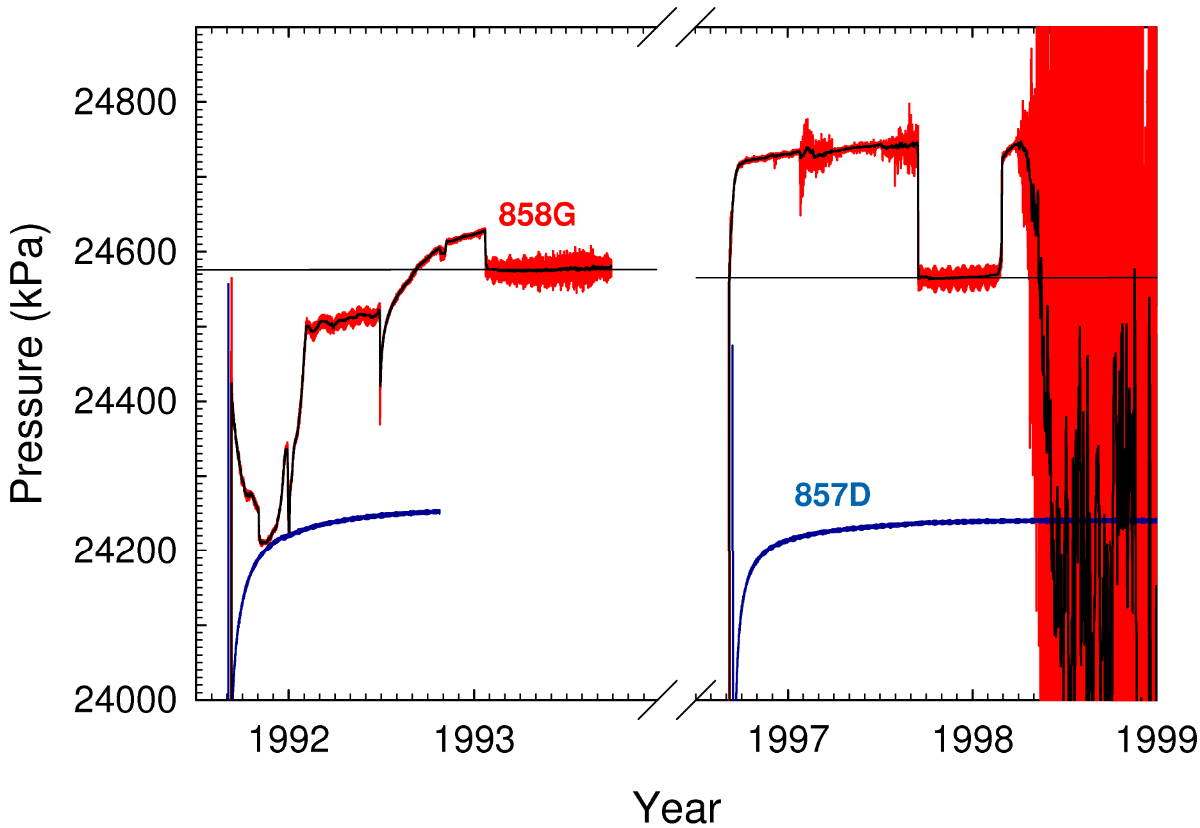


Figure F14. Formation pressures (1 day running averages) in Hole 857D since the second CORK installation during ODP Leg 169. Seismotectonic events from various local and regional sources are indicated with downward pointing arrows. The transient in 2010 was produced when a parallel current-generation instrument was hydraulically connected for high-resolution monitoring, optical communications system testing, and NEPTUNE compatibility.

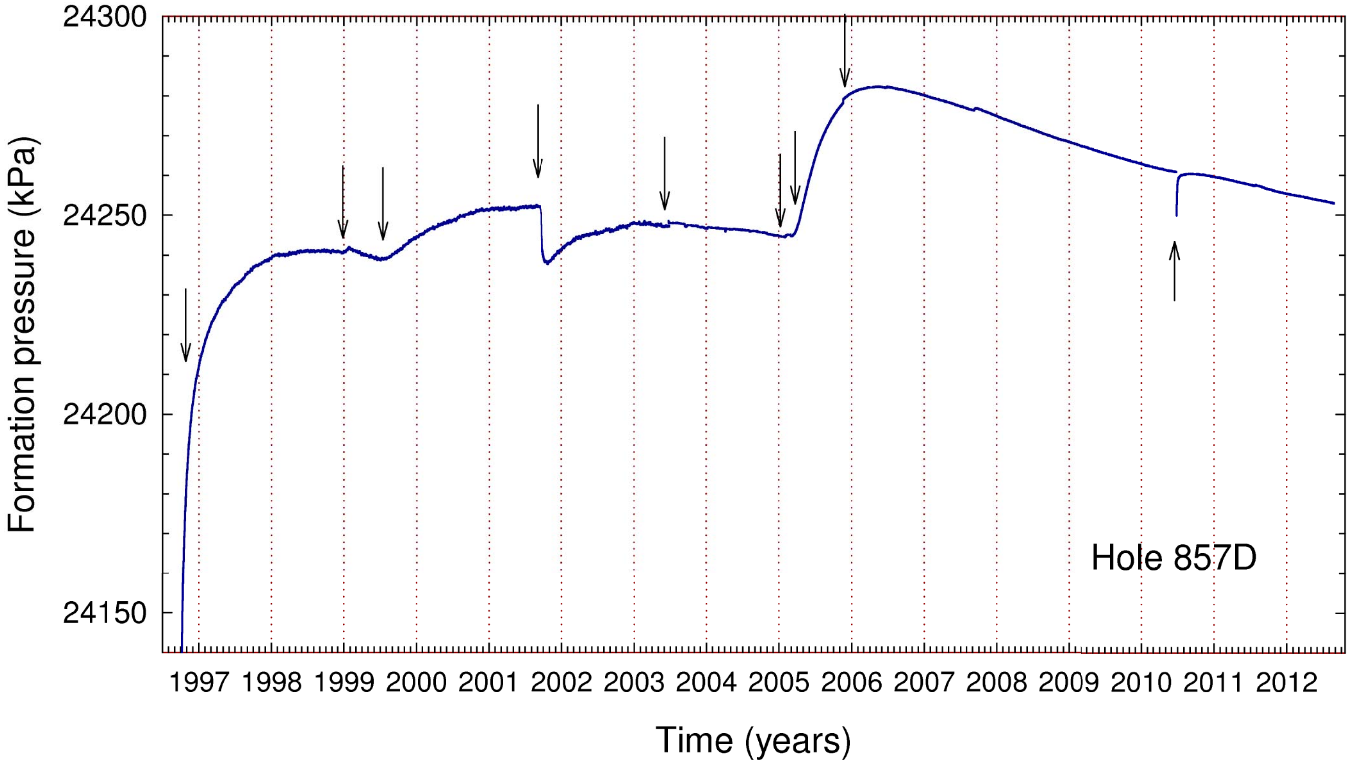


Figure F15. Pressure transient (tides filtered) associated with a seismic swarm in the northern part of Middle Valley. The transient reflects dilatational elastic strain, postseismic strain, and hydrologic diffusion (Davis et al., 2004). Watching future events like this and others seen in Fig. **F14** with observatories at both Holes 857D and 858G will allow the hydrologic and geodynamic components to be separated.

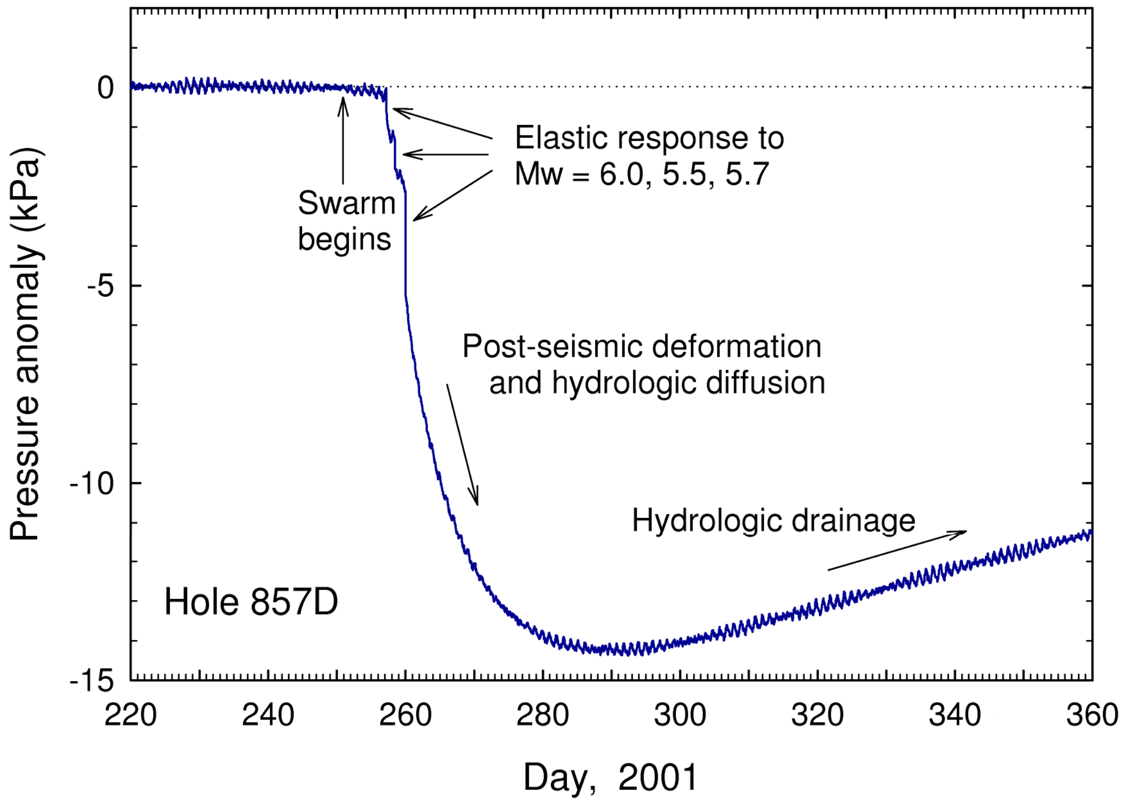


Figure F16. Schematic illustration of design of the new CORK to be installed in Hole 858G. **A.** The wellhead seal. (Continued on next three pages.)

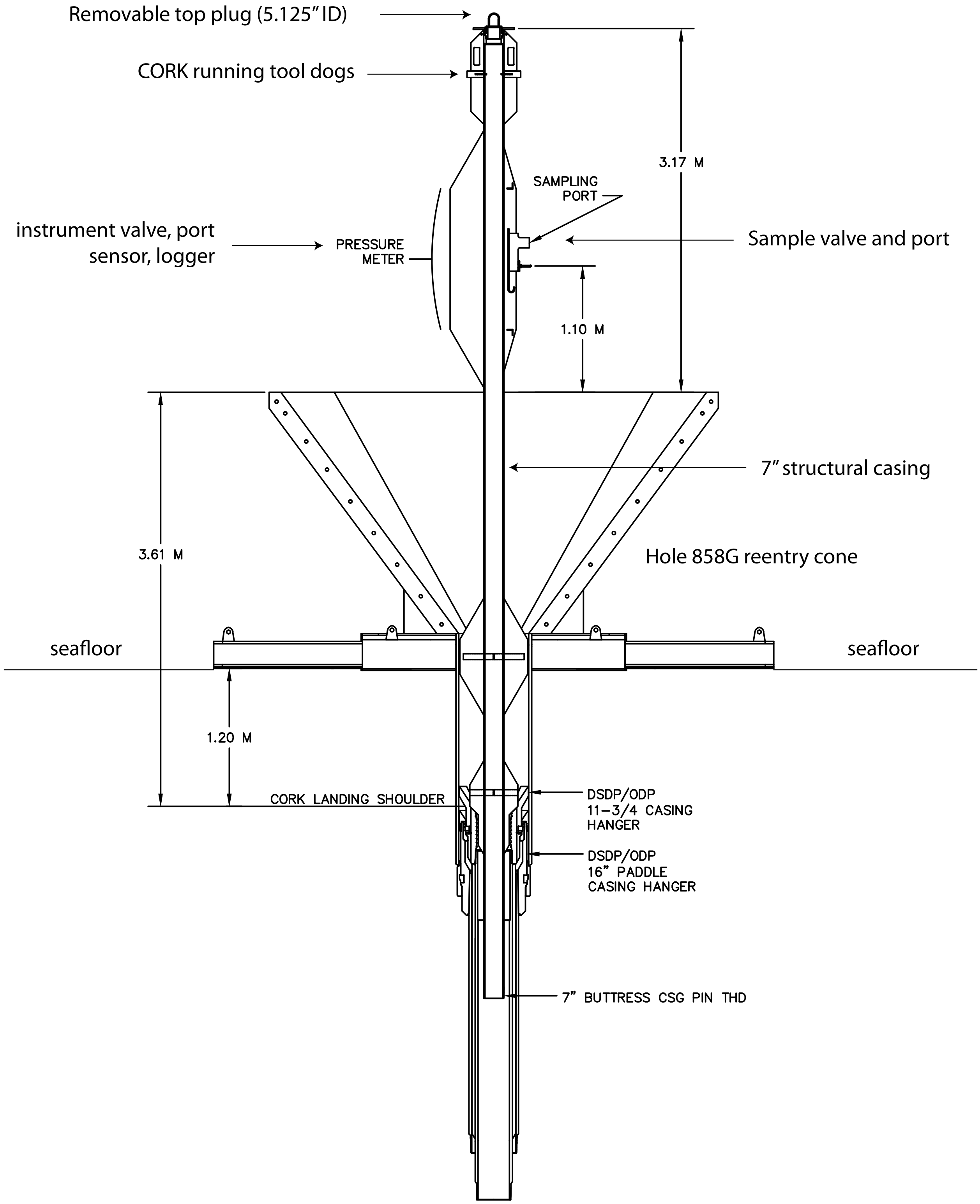


Figure F16 (continued). B. The top plug that seals the inner diameter of the CORK through which the borehole can be accessed. (Continued on next page.)

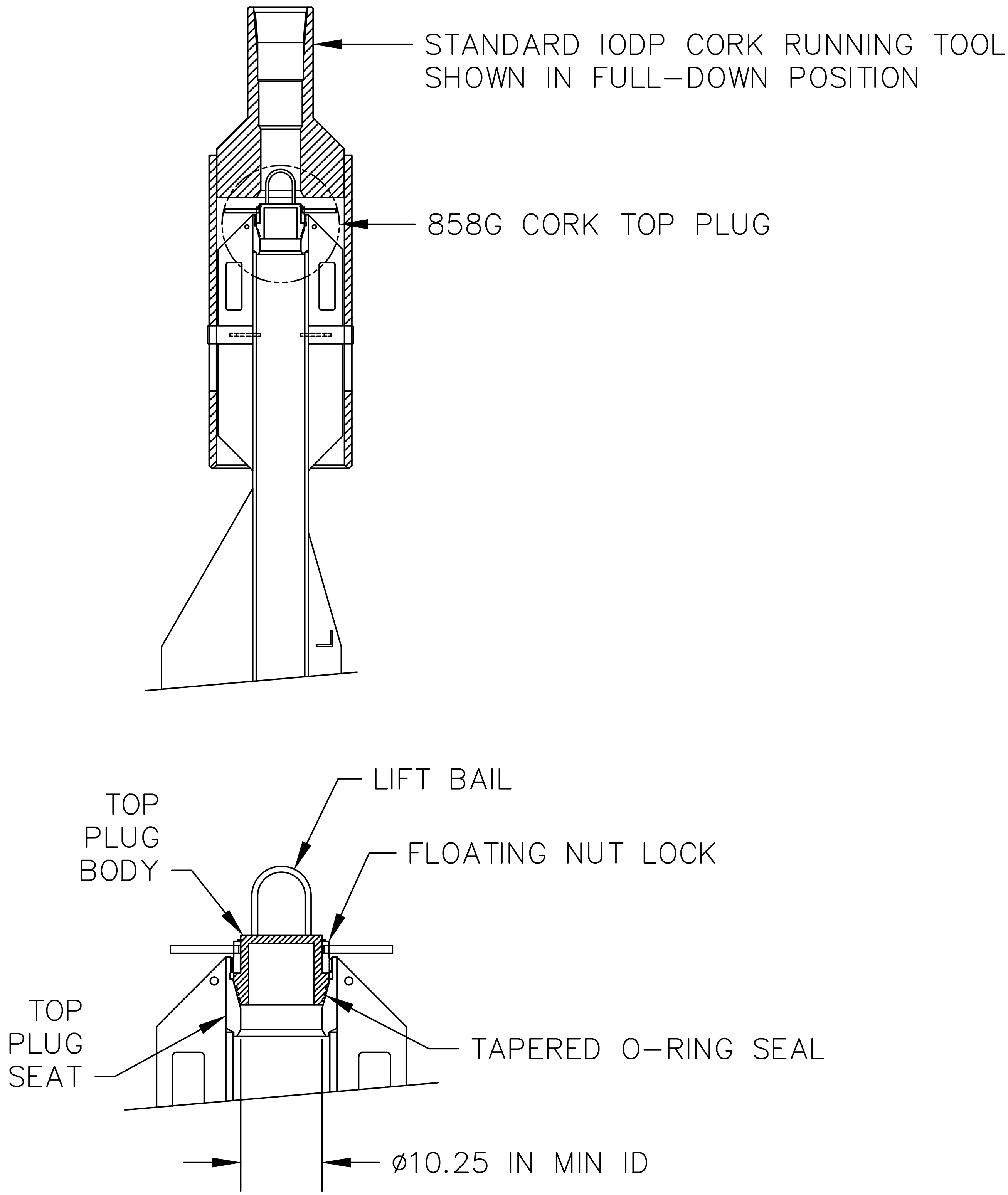


Figure F16 (continued). C. The cup seals that will seal inside the 11.75 inch casing. (Continued on next page.)

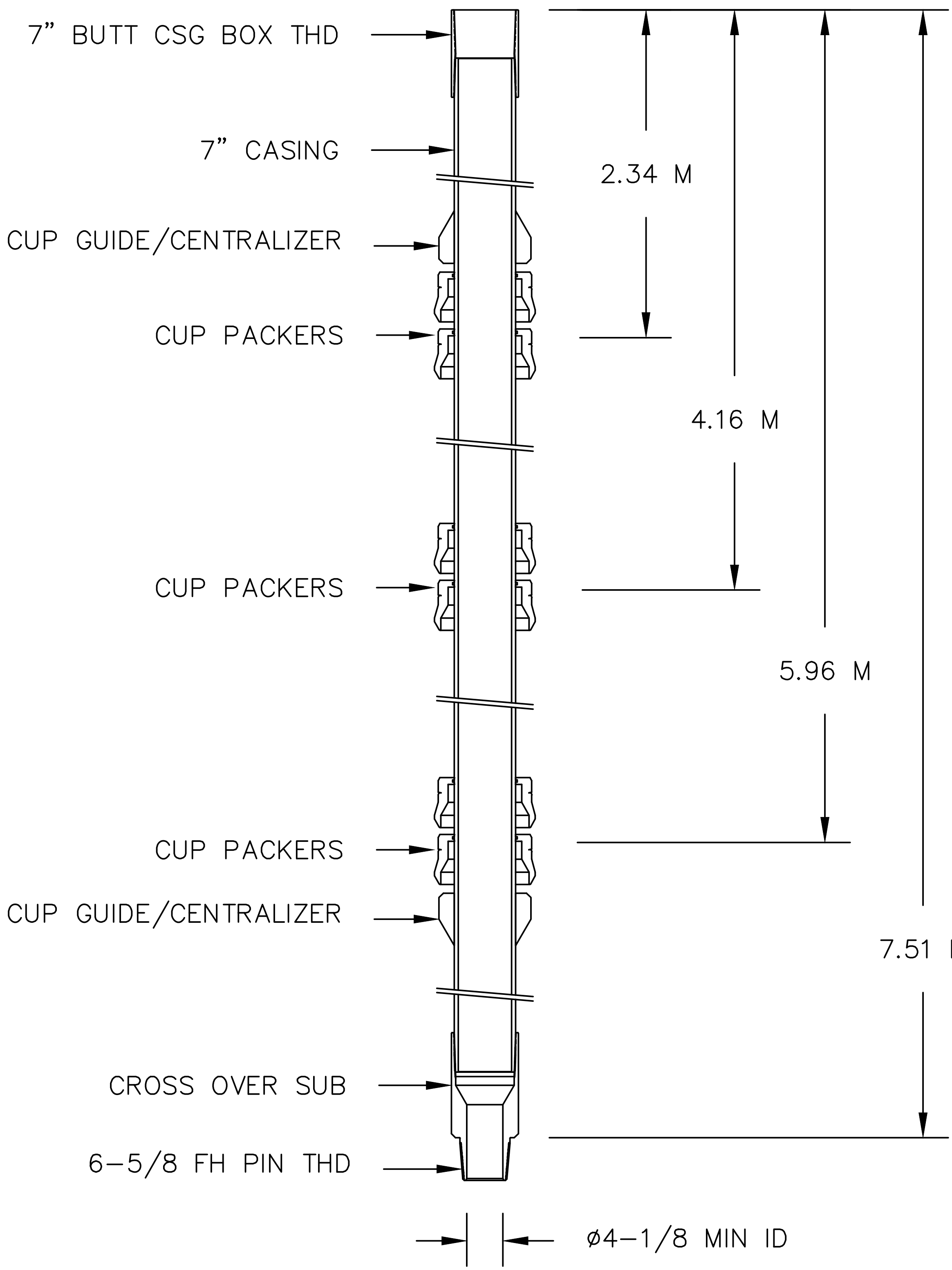
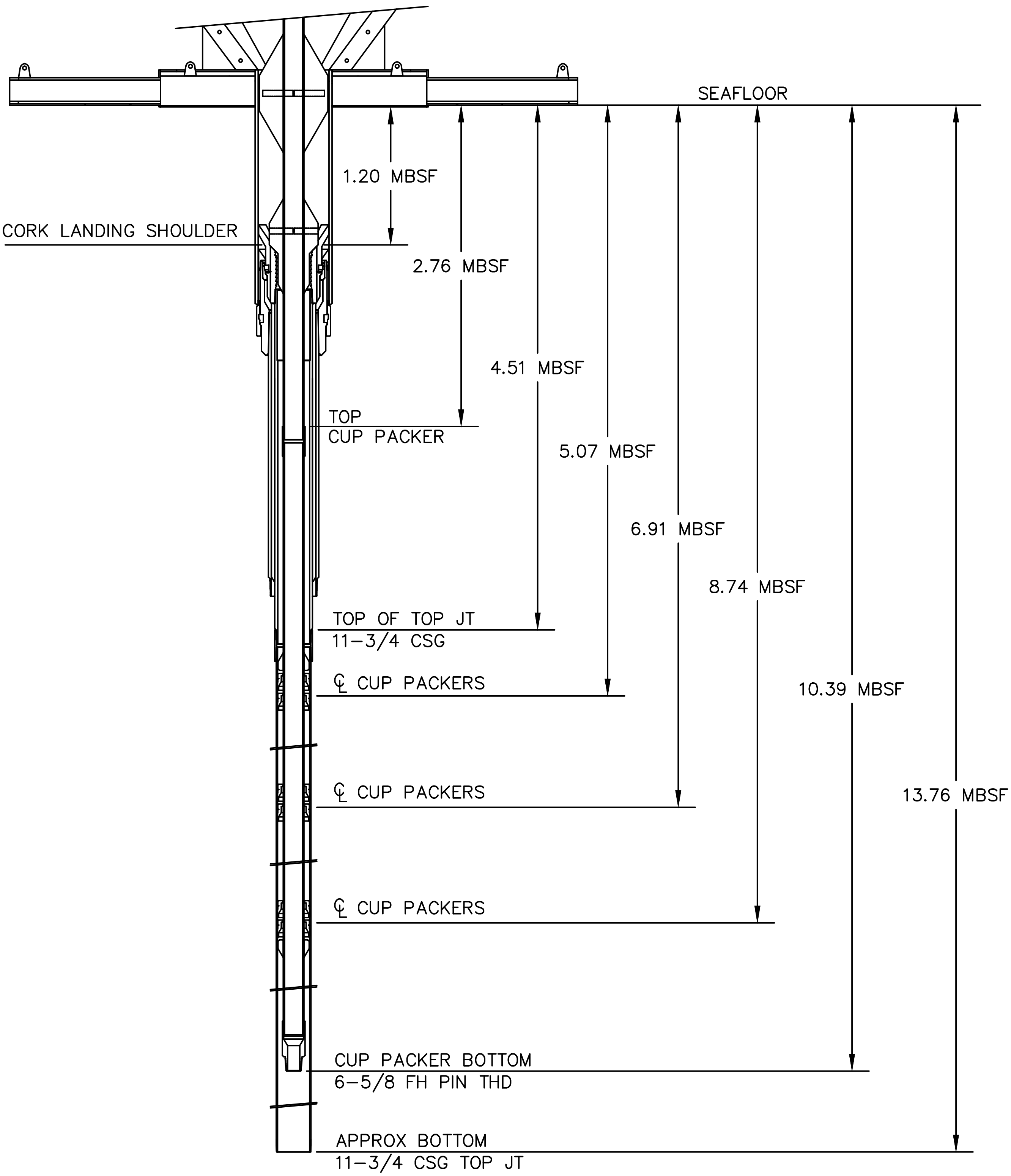


Figure F16 (continued). D. Detail of subseafloor hardware configuration.



Site summaries

Site CAS05-CORK

Priority:	Primary
Position:	48°40.1797′N, 126°50.8502′W
Water depth (m):	1257
Target drilling depth (mbsf):	300
Approved maximum penetration (mbsf):	Pending Environmental Protection and Safety Panel and Texas A&M Safety Panel reviews
Survey coverage (track map; seismic profile):	Track map: Figure **F5** High-resolution seismic: MCS CRL 48 (XL07), CDP 2569: Figure **F8** MCS CRL13 (Inline30) CDP 1390: Figure **F6** Seismic grip: MCS COAMS 3D: inline 30; crossline 725 High-resolution AUV data: Figures **AF1** and **AF2**
Objective(s):	Install SCIMPI
Drilling program:	(1) Drill hole without coring, (2) deploy SCIMPI (see Table **T2**)
Downhole measurements program:	Long-term SCIMPI installation includes measurements of temperature, pressure, conductivity, and resistivity
Nature of rock anticipated:	Deep-sea marine mud interbedded with sand/silt-rich turbidites

Site summaries (continued)

Site CAS10-SCIMPI

Priority:	Alternate
Position:	48°40.095425′N, 126°51.01308′W
Water depth (m):	1262
Target drilling depth (mbsf):	300
Approved maximum penetration (mbsf):	Pending Environmental Protection and Safety Panel and Texas A&M Safety Panel reviews
Survey coverage (track map; seismic profile):	Track map: Figure **F5** High-resolution seismic: MCS CRL 09-Inline28, CDP 3492: Figure **AF3** MCS CRL48 (XL-07) CDP 2562: Figure **F8** Seismic grip: MCS COAMS 3D Inline 28, XL 722 High-resolution AUV data: Figures **AF2** and **AF4**
Objective(s):	Install SCIMPI
Drilling program:	(1) Drill hole without coring, (2) deploy SCIMPI (see Table **T2**)
Downhole measurements program:	Long-term SCIMPI installation includes measurements of temperature, pressure, conductivity, and resistivity
Nature of rock anticipated:	Deep-sea marine mud interbedded with sand/silt-rich turbidites

Site summaries (continued)

Site CAS11-SCIMPI

Priority:	Alternate
Position:	48°41.996992′N, 126°52.0543′W
Water depth (m):	1310
Target drilling depth (mbsf):	300
Approved maximum penetration (mbsf):	Pending Environmental Protection and Safety Panel and Texas A&M Safety Panel reviews
Survey coverage (track map; seismic profile):	Track map: Figure **F9** High-resolution seismic: MCS CRL 12-Inline38, CDP 2600: Figure **AF3** Deep penetration seismic reflection Seismic grid: MCS COAMS 3D: inline 38; crossline 353 SCS line 2004_001_06_19_57 SP 424: Figure **F10** High-resolution AUV data: Figures **AF5** and **AF6**
Objective(s):	Install SCIMPI
Drilling program:	(1) Drill hole without coring, (2) deploy SCIMPI (see Table **T2**)
Downhole measurements program:	Long-term SCIMPI installation includes measurements of temperature, pressure, conductivity, and resistivity
Nature of rock anticipated:	Deep-sea marine mud interbedded with sand/silt-rich turbidites

Site summaries (continued)

Hole 858G re-CORK

Priority:	Primary
Position:	48° 27.360′N, 128°42.531′W
Water depth (m):	2415
Target drilling depth (mbsf):	No drilling planned; only CORK replacement
Approved maximum penetration (mbsf):	Not applicable
Survey coverage (track map; seismic profile):	See ODP Leg 139 and 169 *Initial Reports* (Davis, Mottl, Fisher, et al., 1992; Fouquet, Zierenberg, Miller, et al., 1998)
Objective(s):	Replace CORK observatory
Drilling program:	(1) Retrieve Leg 169 CORK, (2) install new CORK (see Table **T2**)
Downhole measurements program:	Installation of long-term CORK observatory including measurements of temperature and pressure
Nature of rock anticipated:	Not applicable

Figure AF1. High-resolution 3.5 kHz subbottom profiler data acquired with an autonomous underwater vehicle (AUV) by Monetary Bay Aquarium Research Institute (MBARI) for Site CAS05-CORK. V.E. = vertical exaggeration. (Courtesy C.K. Paull and D.W. Caress, MBARI.)

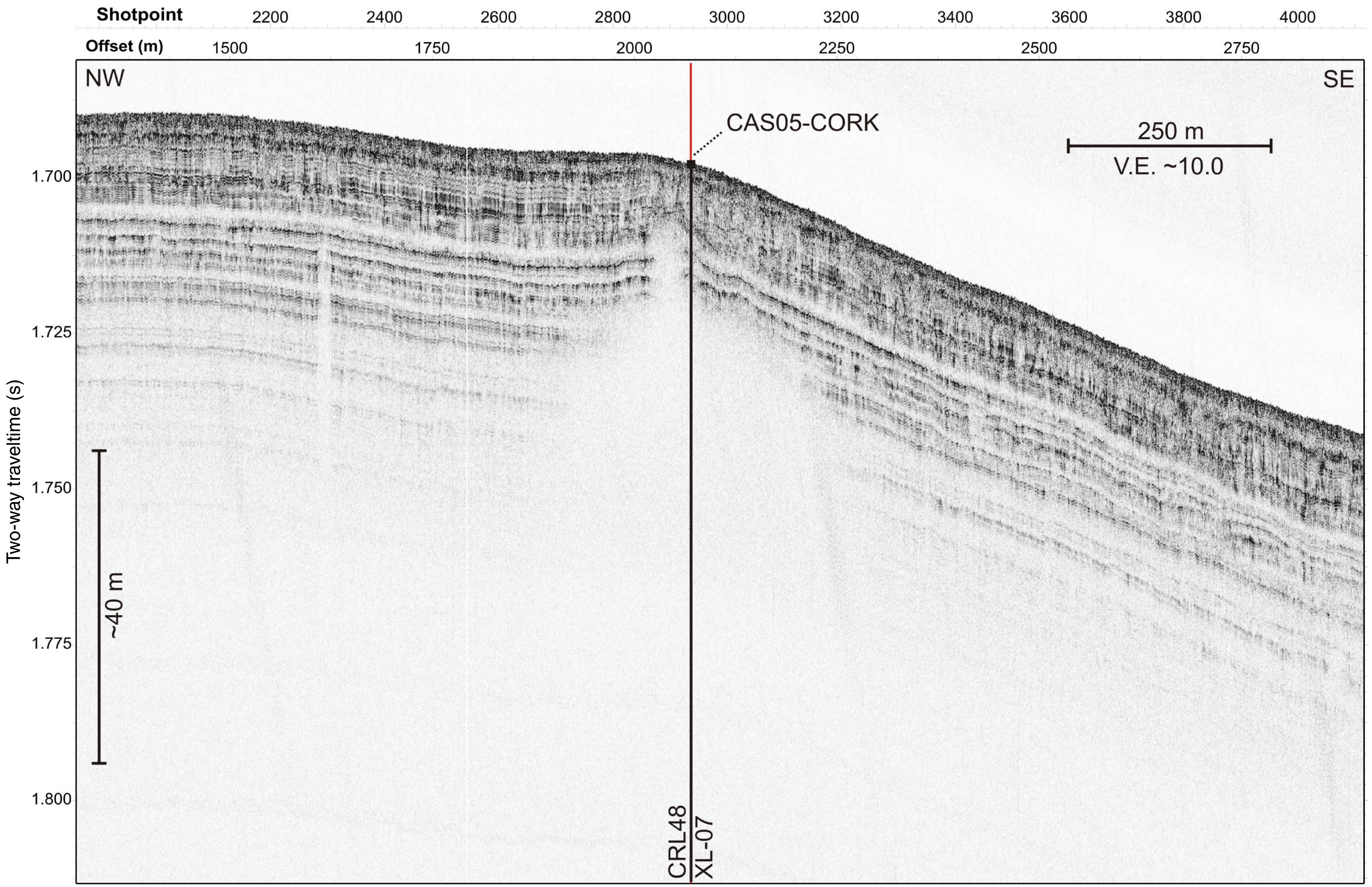


Figure AF2. High-resolution 3.5 kHz subbottom profiler data acquired with an autonomous underwater vehicle (AUV) by Monetary Bay Aquarium Research Institute (MBARI) for Sites CAS10-SCIMPI and CAS05-CORK. V.E. = vertical exaggeration. (Courtesy C.K. Paull and D.W. Caress, MBARI.)

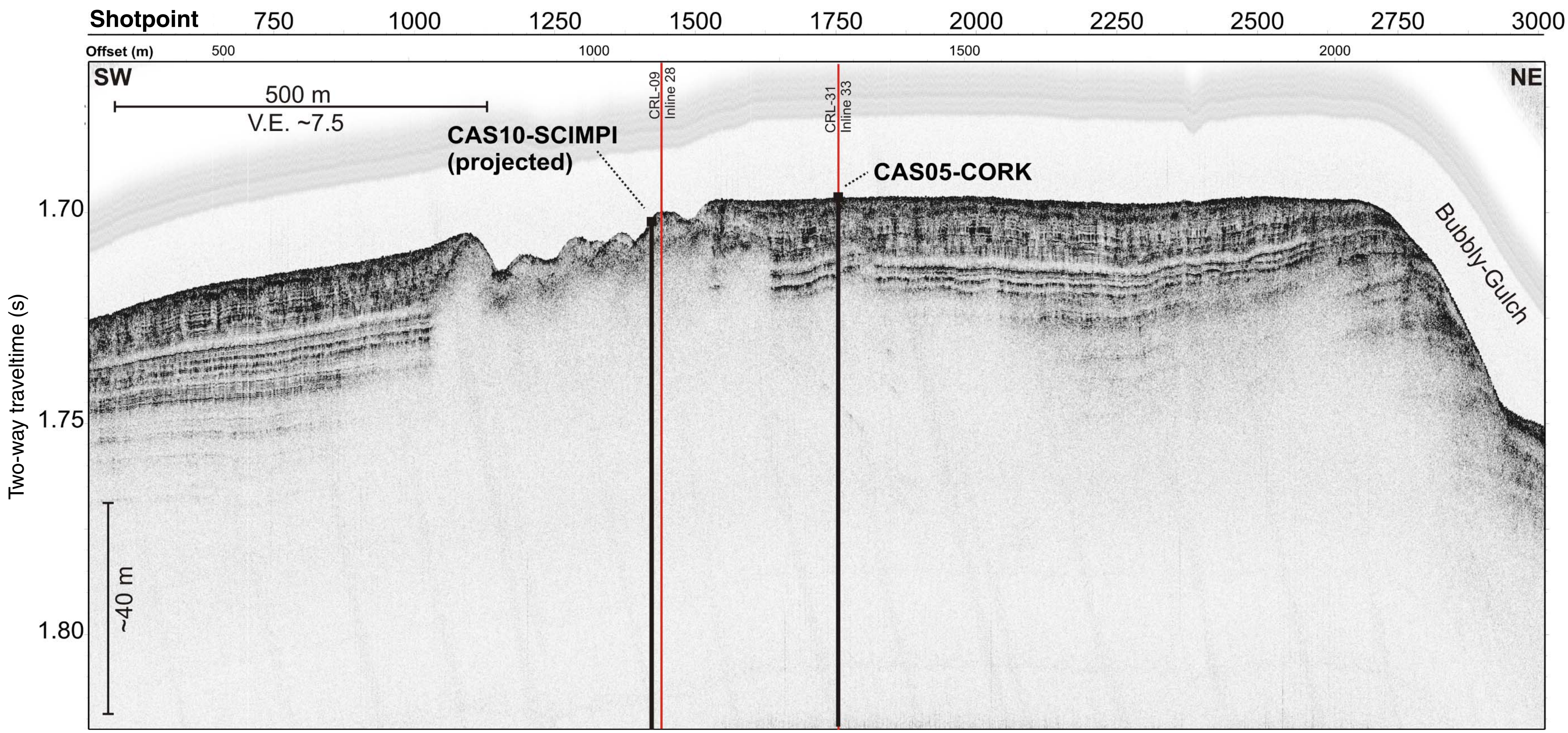


Figure AF3. Multichannel seismic data for Site CAS10-SCIMPI. CDP = common depth point, V.E. = vertical exaggeration.

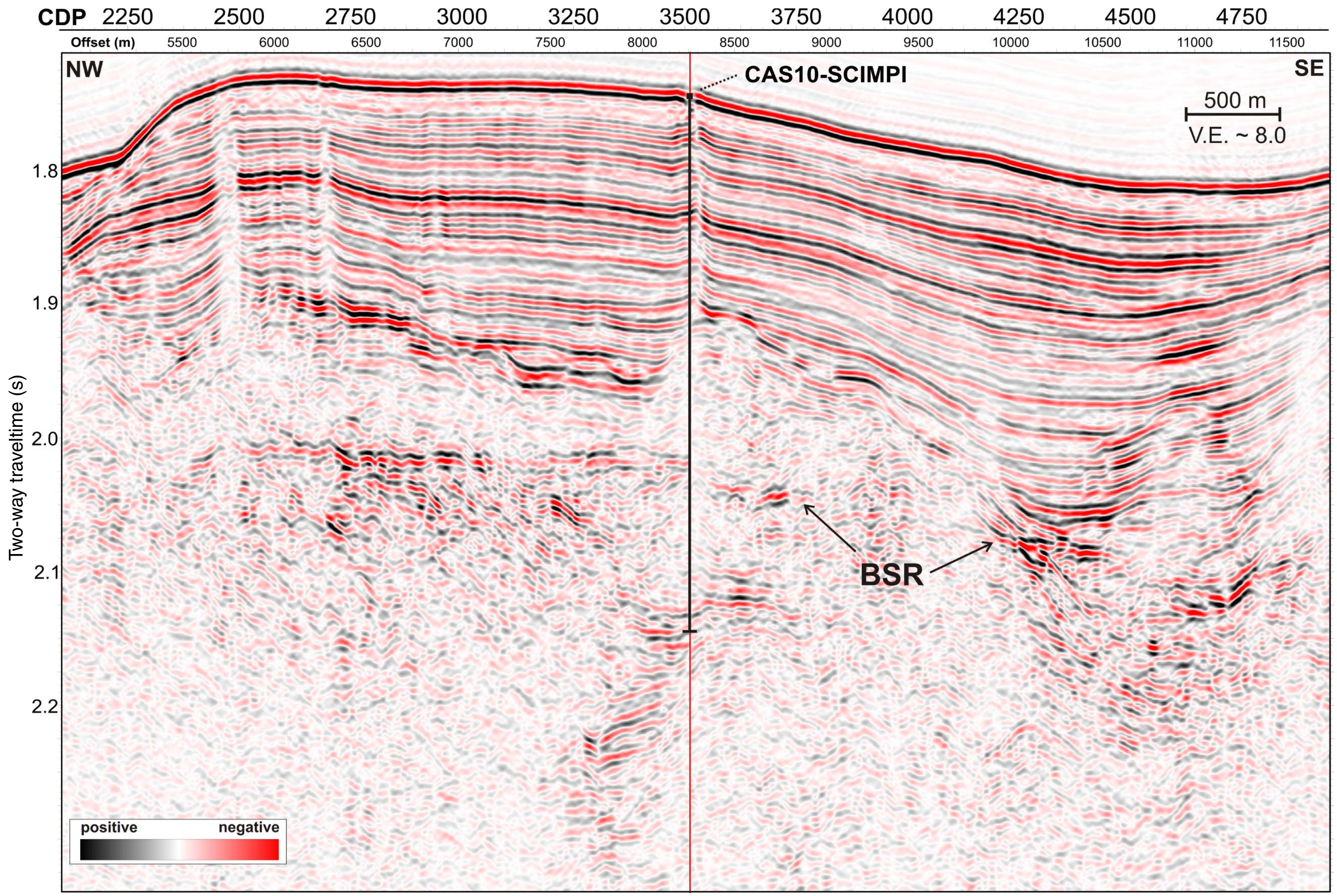


Figure AF4. High-resolution 3.5 kHz subbottom profiler data acquired with an autonomous underwater vehicle (AUV) by Monetary Bay Aquarium Research Institute (MBARI) for Site CAS10-SCIMPI. V.E. = vertical exaggeration. (Courtesy C.K. Paull and D.W. Caress, MBARI.)

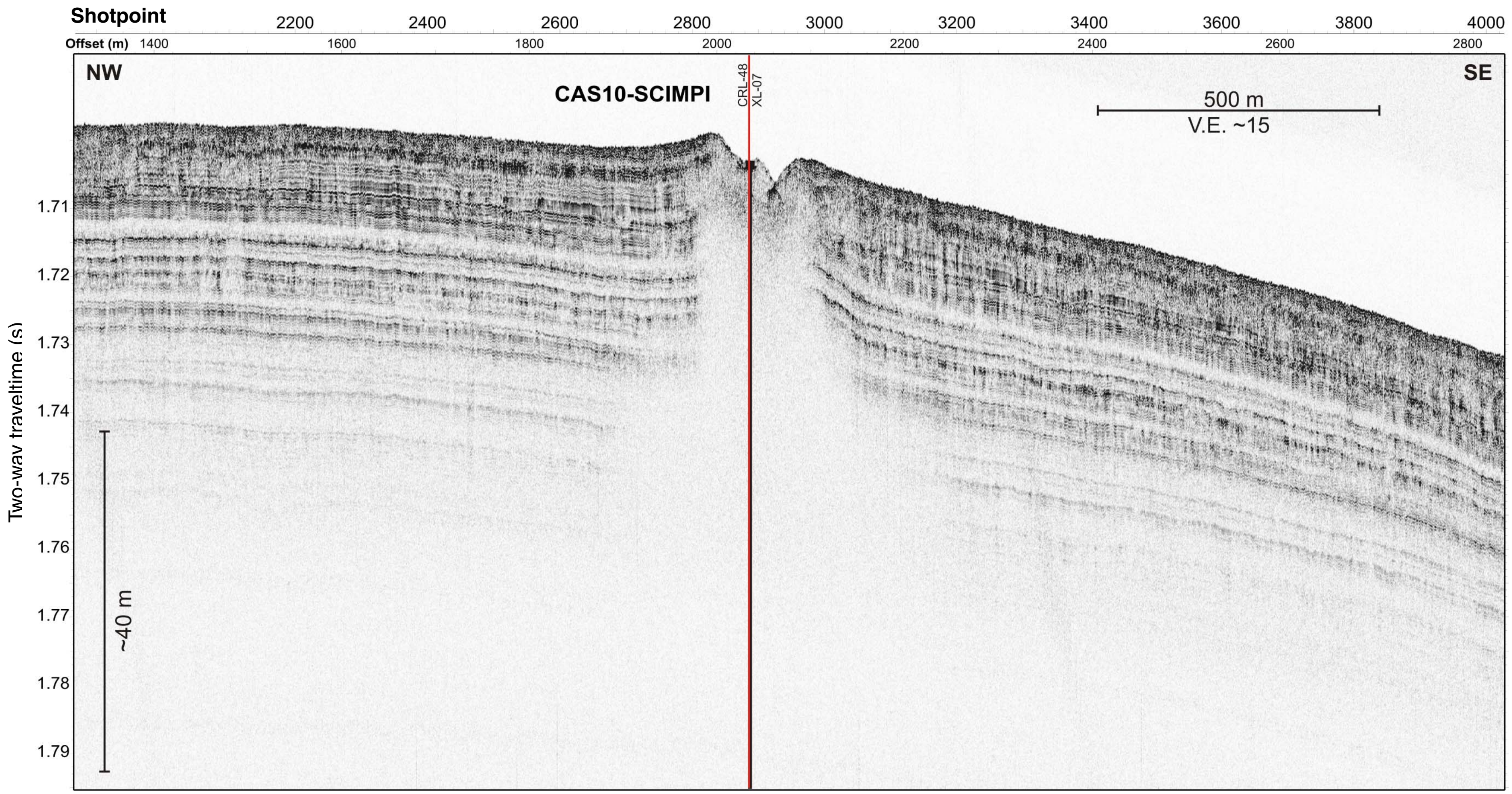


Figure AF5. High-resolution 3.5 kHz subbottom profiler data acquired with an autonomous underwater vehicle (AUV) by Monetary Bay Aquarium Research Institute (MBARI) for Sites CAS11-SCIMPI and U1327. V.E. = vertical exaggeration. (Courtesy C.K. Paull and D.W. Caress, MBARI.)

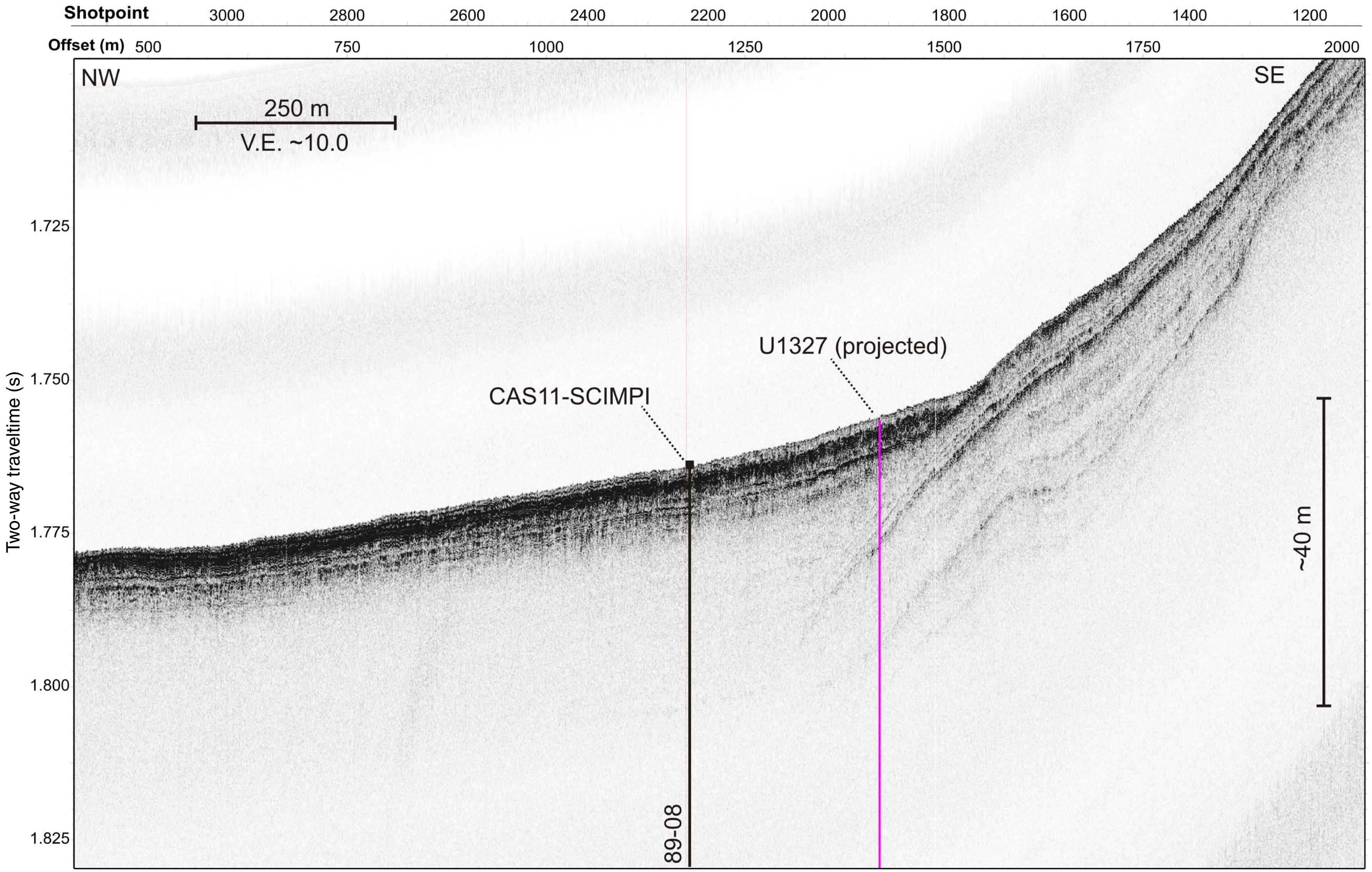
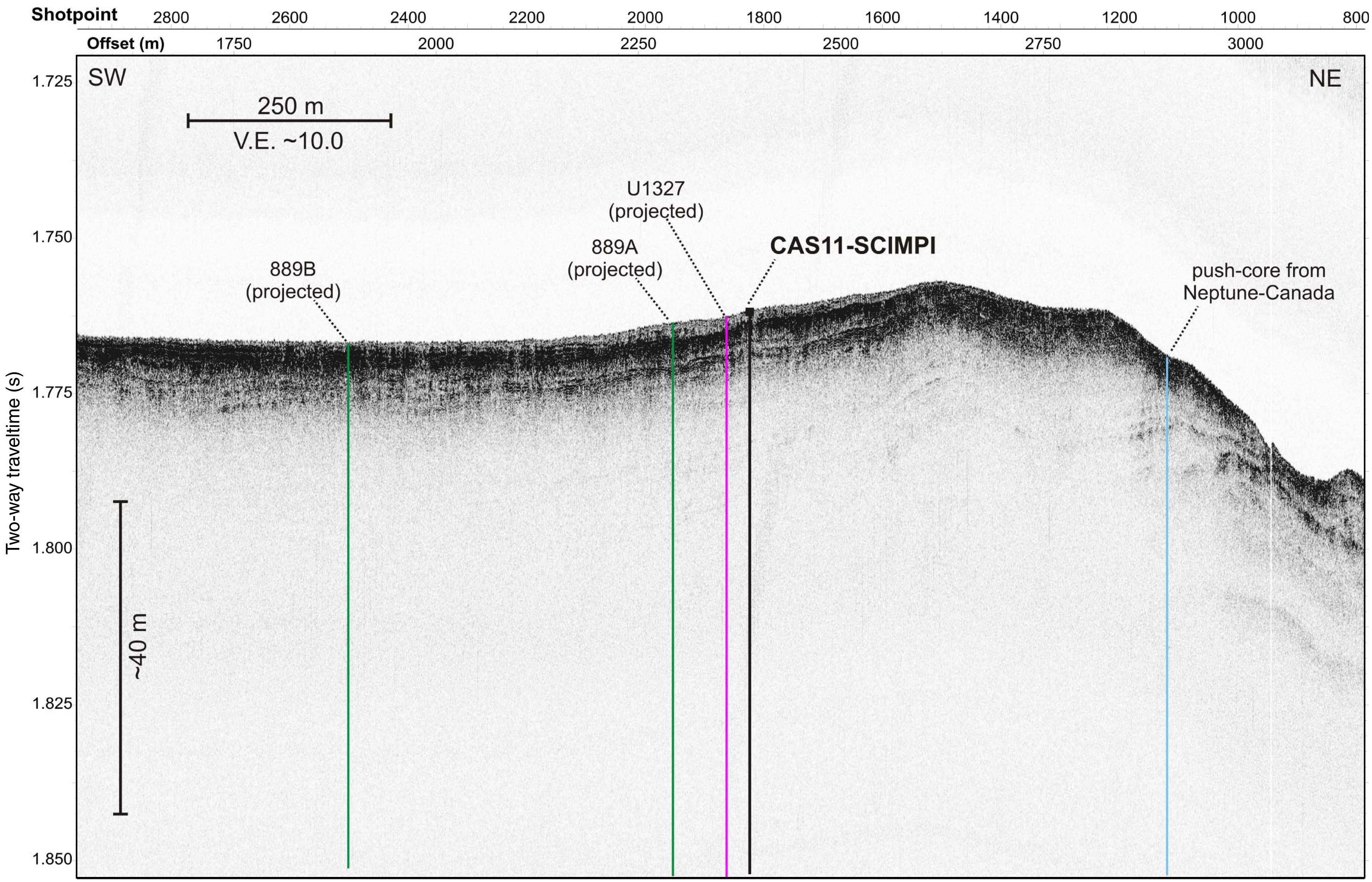


Figure AF6. High-resolution 3.5 kHz subbottom profiler data acquired with an autonomous underwater vehicle (AUV) by Monetary Bay Aquarium Research Institute (MBARI) for Sites 889B, 889A, U1327, CAS11-SCIMPI, and the push-core from NEPTUNE-Canada. V.E. = vertical exaggeration. (Courtesy C.K. Paull and D.W. Caress, MBARI.)



Expedition scientists and scientific participants

The current list of participants for Expedition 341S can be found at **iodp.tamu.edu/scienceops/expeditions/scimpi.html.**