International Ocean Discovery Program
Expedition 365 Scientific Prospectus

NanTroSEIZE Stage 3: Shallow Megasplay Long-Term Borehole Monitoring System (LTBMS)

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Abstract

The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) program is a coordinated, multiexpedition drilling project designed to investigate fault mechanics and seismogenesis along subduction megathrusts through direct sampling, in situ measurements, and long-term monitoring in conjunction with allied laboratory and numerical modeling studies. The fundamental scientific objectives of the NanTroSEIZE drilling project include characterizing the nature of fault slip and strain accumulation, fault and wall rock composition, fault architecture, and state variables throughout the active plate boundary system.

International Ocean Discovery Program (IODP) Expedition 365 will recover temporary monitoring instruments (a "GeniusPlug") from previously drilled and cased Integrated Ocean Drilling Program Site C0010 and deploy a permanent long-term borehole monitoring system (LTBMS) in the same hole after deepening it to ~656 meters below seafloor (mbsf). These operations will complete preparations begun during Integrated Ocean Drilling Program Expedition 319 and continued during Integrated Ocean Drilling Program Expedition 332. This expedition will cover a period of 33 days, beginning on 26 March and ending on 27 April 2016.

Site C0010 is located 3.5 km north of Integrated Ocean Drilling Program Site C0004 and was first drilled during Expedition 319. Operations during that expedition included drilling through the megasplay fault zone and into its footwall using logging while drilling (LWD), setting casing with screens spanning the fault zone, and installation of a simple temporary observatory (a "SmartPlug") to monitor fluid pressure and temperature in the screened interval. Major lithologic boundaries as well as the location of the megasplay fault at ~407 mbsf were identified in LWD data and were used to select a depth interval spanning the fault for placement of the two screened casing joints. Three distinct lithologic packages were observed at Site C0010: slope deposits (Unit I, 0–182.5 mbsf), thrust wedge (Unit II, 182.5–407 mbsf), and overridden slope deposits (Unit III, 407 mbsf to total depth). During Expedition 332, the SmartPlug was recovered and replaced with an upgraded version, the GeniusPlug, which includes a set of geochemical and biological experiments housed in a 30 cm extension. This GeniusPlug will be recovered and replaced with a permanent LTBMS, which will be later linked to the Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) submarine network. This *Scientific Prospectus* outlines the scientific rationale, objectives, and operational plans for Site C0010 and describes the contingency plan.

Schedule for Expedition 365

The operations schedule for International Ocean Discovery Program (IODP) Expedition 365 is derived from the original Integrated Ocean Drilling Program drilling Proposals 603-CDP3, 603C-Full, and 603D-Full2 (available for download at **http://www.iodp.org/600**). The D/V *Chikyu* IODP Board has charged the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) Project Coordination Team (PCT) with formulating a strategy to achieve the overall scientific objectives outlined in all of the NanTroSEIZE program proposals. The overarching goals and multistage implementation strategy are described in Tobin and Kinoshita (2006a, 2006b).

Expedition 365 is the fourth NanTroSEIZE Stage 3 expedition and is currently scheduled to begin on 26 March 2016. Details of the operational schedule, updates to the drilling schedule, and operational and layout details of the *Chikyu* can be found at **http://www.jamstec.go.jp/chikyu/e/chikyuexp**. The entire expedition comprises a total of 33 days (including 5 days of contingency time) for GeniusPlug recovery, drilling to deepen the hole, and long-term borehole monitoring system (LTBMS) installation (Table **T1**), as described in this *Scientific Prospectus*.

Introduction

Overview of the NanTroSEIZE drilling project

Subduction zones account for 90% of global seismic moment release and generate damaging earthquakes and tsunamis with potentially disastrous effects on heavily populated coastal areas (e.g., Lay et al., 2005; Moreno et al., 2010; Simons et al., 2011). Understanding the processes that govern the strength, nature, and distribution of slip along these plate boundary fault systems is a crucial step toward evaluating earthquake and tsunami hazards. More generally, characterizing fault slip behavior and mechanical state at all plate boundary types through direct sampling, near-field geophysical observations, measurement of in situ conditions, and shore-based laboratory experiments is a fundamental and societally relevant goal of modern earth science. To this end, several recent and ongoing drilling programs have targeted portions of active plate boundary faults that have either slipped coseismically during large earthquakes or nucleated smaller events. These efforts include the San Andreas Fault Observatory at Depth (Hickman et al., 2004), the Taiwan-Chelungpu Drilling Project (Ma, 2005), and Integrated Ocean Drilling Program drilling in the Nankai Trough (NanTroSEIZE; Tobin and Kinoshita, 2006a, 2006b) and in the high-slip region of the March 2011 Tohoku earthquake (JFAST; Chester, Mori, Eguchi, Toczko, and the Expedition 343/343T Scientists 2013).

The NanTroSEIZE project is a multiexpedition, multistage IODP drilling project focused on understanding the mechanics of seismogenesis and rupture propagation along subduction plate boundary faults. NanTroSEIZE includes a coordinated effort to sample and instrument the plate boundary system at several locations offshore the Kii Peninsula, Japan (Tobin and Kinoshita, 2006a, 2006b) (Figures **F1**, **F2**). The main objectives are to understand

- The mechanisms and processes controlling the updip aseismic–seismic transition of the megathrust fault system;
- Processes of earthquake and tsunami generation;
- Mechanics of strain accumulation and release;
- The absolute mechanical strength of the plate boundary fault; and
- The potential role of a major upper plate fault system (termed the "megasplay" fault) in seismogenesis and tsunamigenesis.

The drilling program will evaluate a set of core hypotheses through riser and riserless drilling, long-term observatories, and associated geophysical, laboratory, and numerical modeling efforts. The following hypotheses are paraphrased from the original Integrated Ocean Drilling Program proposals and outlined in Tobin and Kinoshita (2006a, 2006b):

1. Systematic, progressive material and state changes control the onset of seismogenic behavior on subduction thrust faults.
2. Subduction megathrusts are weak faults.
3. Plate motion is accommodated primarily by coseismic frictional slip in a concentrated zone (i.e., the fault is locked during the interseismic period).

4. Physical properties of the plate boundary system (including the fault system and its hanging wall and footwall) change with time during the earthquake cycle.
5. A significant, laterally extensive upper plate fault system (the megasplay fault; Park et al., 2002) slips in discrete events that may include tsunamigenic slip during great earthquakes. It remains locked during the interseismic period and accumulates strain.

Sediment-dominated subduction zones such as the East Aleutian, Cascadia, Sumatra, and Nankai margins are characterized by repeated occurrences of great earthquakes of ~Mw 8.0+ (Ruff and Kanamori, 1983). Although the causal mechanisms are not well understood (e.g., Byrne et al., 1988; Moore and Saffer, 2001; Saffer and Marone, 2003) and great earthquakes are also known to occur within sediment-starved subduction zones such as the Japan Trench, the updip limit of the seismogenic zones at these margins is thought to correlate with a topographic break, often associated with the outer rise (e.g., Byrne et al., 1988, Wang and Hu, 2006). Along the Nankai margin, high-resolution seismic reflection profiles across the outer rise clearly document a large out-of-sequence-thrust fault system (the megasplay fault, after Park et al., 2002) that branches from the plate boundary décollement close to the updip limit of inferred coseismic rupture in the 1944 Tonankai Mw 8.2 earthquake (Figure **F1**). Several lines of evidence indicate that the megasplay system is active and that it may accommodate an appreciable component of plate boundary motion. However, the partitioning of strain between the lower plate interface (the décollement zone) and the megasplay system, as well as the nature and mechanisms of fault slip as a function of depth and time on the megasplay are not understood. As stated in the fifth hypothesis above, one of the first-order goals in characterizing the seismogenic zone along the Nankai Trough, which bears on both understanding subduction zone megathrust behavior globally and defining tsunami hazards, is to document the role of the megasplay fault in accommodating plate motion (both seismically and interseismically) and to characterize its mechanical and hydrologic behavior.

Background

Geological setting

The Nankai Trough is formed by subduction of the Philippine Sea plate to the northwest beneath the Eurasian plate at a rate of ~40–60 mm/y (Seno et al., 1993; Miyazaki and Heki, 2001). The convergence direction is slightly oblique to the trench, and sediments of the Shikoku Basin are actively accreting at the deformation front. The Nankai Trough is among the most extensively studied subduction zones in the world, and great earthquakes during the past 1300 or more years are well documented in historical and archaeological records (e.g., Ando, 1975). It has been one of the focus sites for studies of seismogenesis by both the Integrated Ocean Drilling Program and the U.S. MARGINS initiative, based on the wealth of geological and geophysical data available. A better understanding of seismic and tsunami behavior at margins such as Nankai is highly relevant to heavily populated coastal areas globally.

The Nankai Trough region has a 1300 y historical record of recurring great earthquakes that are typically tsunamigenic, including the 1944 Tonankai Mw 8.2 and 1946 Nankaido Mw 8.3 earthquakes (Ando, 1975; Hori et al., 2004). The rupture area and zone of tsunami generation for the 1944 event (within which the site of this IODP expedition is located) are now reasonably well understood (Ichinose et al., 2003; Baba et al., 2005). Land-based geodetic studies suggest that currently the plate boundary thrust is strongly locked (Miyazaki and Heki, 2001). Similarly, the relatively low level of microseismicity near the updip limits of the 1940s earthquakes (Obana et al., 2001) implies significant interseismic strain accumulation on the megathrust. However, recent observations of very low frequency (VLF) earthquakes within or just below the accretionary prism in the drilling area (Obara and Ito, 2005) demonstrate that interseismic strain is not confined to slow elastic strain accumulation. Slow slip phenomena, referred to as episodic tremor and slip, including episodic slow slip events and nonvolcanic tremor (Schwartz and Rokosky, 2007), are also widely known to occur in the downdip part of the rupture zone (Ito et al., 2007). In the subducting Philippine Sea plate mantle below the rupture zone, weak seismicity is observed (Obana et al., 2005). Seaward of the subduction zone, deformation of the incoming ocean crust is suggested by microearthquakes as documented by ocean-bottom seismometer (OBS) studies (Obana et al., 2005).

The region offshore the Kii Peninsula on Honshu Island was selected for seismogenic zone drilling for several reasons. First, the rupture area of the most recent great earthquake, the 1944 Mw 8.2 Tonankai event, is well constrained by recent seismic and tsunami waveform inversions (e.g., Tanioka and Satake, 2001; Kikuchi et al., 2003). Slip inversion studies suggest that only in this region did past coseismic rupture clearly extend shallow enough for drilling (Ichinose et al., 2003; Baba and Cummins, 2005), and an updip zone of large slip has been identified and targeted (Figure **F2**). Notably, coseismic slip during events like the 1944 Tonankai earthquake may have occurred on the megasplay fault in addition to the plate boundary décollement (Ichinose et al., 2003; Baba et al., 2006). The megasplay fault is therefore a primary drilling target equal in importance to the basal décollement. Second, OBS campaigns and onshore high-resolution geodetic studies (though of short duration) indicate significant interseismic strain accumulation (e.g., Miyazaki and Heki, 2001; Obana et al., 2001). Third, the region offshore the Kii Peninsula is generally typical of the Nankai margin in terms of heat flow and sediment on the incoming plate. This is in contrast to the area offshore Cape Muroto (the location of previous scientific ocean drilling), where both local stratigraphic variations associated with basement topography and anomalously high heat flow have been documented (Moore et al., 2001, 2005; Moore and Saffer, 2001). Finally, the drilling targets are within the operational limits of riser drilling by *Chikyu* (i.e., maximum of 2500 m water depth and 7000 m subseafloor penetration). In the seaward portions of the Kumano Basin, the seismogenic zone lies ~4700–6000 m beneath the seafloor (Nakanishi et al., 2002).

Seismic studies and site survey data

A significant volume of site survey data has been collected in the drilling area over many years, including multiple generations of 2-D seismic reflection (e.g., Park et al., 2002), wide-angle refraction (Nakanishi et al., 2002), passive seismicity (e.g., Obara et al., 2004), heat flow (Yamano et al., 2003), side-scan sonar, swath bathymetry, and submersible and remotely operated vehicle (ROV) dive studies (Ashi et al., 2002). In 2006, Japan and the United States conducted a joint 3-D seismic reflection survey over a ~11 km × 55 km area, acquired by PGS Geophysical, an industry service company (Moore et al., 2009). This 3-D data volume was the first deep-penetration, fully 3-D marine survey ever acquired for basic research purposes and has been used to (1) refine selection of drill sites and targets in the complex megasplay fault region, (2) define the 3-D regional structure and seismic stratigraphy, (3) analyze physical properties of the subsurface through seismic attribute studies, and (4) assess drilling safety (Moore et al., 2007, 2009). These high-resolution, 3-D data are being used in conjunction with physical properties, petrophysical, and geophysical data obtained from core analyses and both wireline and logging-while-drilling (LWD) logging to allow extensive and high-resolution integration of core, logs, and seismic data.

The supporting site survey data for Expedition 365 are archived at the IODP Site Survey Data Bank (**http://ssdb.iodp.org/SSDBquery/SSDBquery.php**).

Long-term observatories

The installation of a series of long-term borehole observatories across the study area at Integrated Ocean Drilling Program Sites C0002, C0010, and possibly Site C0006 (Figures **F1**, **F2**) began with operations at Site C0002 during Integrated Ocean Drilling Program Expedition 332 (Kopf et al., 2011). These sites are located within and above regions of contrasting behavior of the megasplay fault zone and plate boundary as a whole. They include a site above the updip edge of the "locked" zone (Site C0002), a shallow site in the megasplay fault zone and footwall where slip is presumed to be aseismic (the target of Expedition 365; Site C0010), and at the tip of the accretionary prism (Site C0006), motivated by observed slip in the 11 March 2011 Tohoku earthquake indicating that at some margins coseismic rupture may propagate along the plate boundary all the way to the trench (e.g., Fujiwara et al., 2011). Together, the suite of NanTroSEIZE observatories has the potential to capture seismic and microseismic activity, slow slip, and interseismic strain accumulation across a transect from the near trench to the seismogenic zone. Such temporally continuous and spatially distributed observations are necessary to understand how each part of the plate boundary functions through the seismic cycle of megathrust earthquakes.

Currently, the planned observation system for Site C0010 consists of an array of sensors designed to monitor slow crustal deformation (e.g., strain, tilt, and pore pressure as a proxy for strain), seismic events including VLF earthquakes, hydrologic transients associated with strain events, ambient pore pressure, and temperature. To ensure the long-term and continuous monitoring necessary to capture events that occur over a wide range of timescales, the borehole observatory will be connected to a submarine cabled observation network called Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) (**http://www.jamstec.go.jp/donet/e**) after the drilling expedition. The LTBMS installed at Site C0002 is already connected to this network, and the data can be viewed and downloaded at an open-access observatory data portal (**http://offshore.geosc.psu.edu/about**).

Scientific objectives

Site C0010 background

The primary plan for Expedition 365 is to recover the currently installed GeniusPlug temporary observatory (Figure **F3**), deepen Hole C0010A from 555 to 656 meters below seafloor (mbsf), underream the hole below the 9⅝ inch casing to a 10 inch diameter, and install the LTBMS. The hole was originally drilled with LWD and cased during Integrated Ocean Drilling Program Expedition 319; operations included drilling with measurement while drilling (MWD)/LWD across the megasplay fault to a total depth (TD) of 555 mbsf, casing the borehole (with casing screens at the fault), conducting an observatory dummy run to test strainmeter and seismometer deployment procedures, and installation of a simple pore pressure and temperature monitoring system (SmartPlug) attached to a retrievable bridge plug (Expedition 319 Scientists, 2010). The hole was revisited during Expedition 332, when the SmartPlug was recovered (see Expedition 332 Scientists, 2011) and replaced with the currently deployed GeniusPlug.

Expedition 319 identified three distinct lithologic packages at Site C0010. From top to bottom, these are hemipelagic slope deposits composed primarily of mud with minor distal turbidite interbeds (logging Unit I, 0–182.5 m LWD depth below seafloor [LSF]), thrust wedge (logging Unit II, 182.5–407 m LSF), and overridden slope deposits (logging Unit III, 407 m LSF to TD). Logging Unit I is divided into two subunits: Subunit IA (0–161.5 m LSF), characterized by gamma ray and resistivity patterns similar to those observed in Unit I at Integrated Ocean Drilling Program Site C0004 (Expedition 314 Scientists, 2009), and Subunit IB (161.5–182.8 m LSF), interpreted as slope sediments composed of material reworked from the underlying thrust wedge. The lithologic interpretation was made from Expedition 319 LWD data combined with core descriptions from previously drilled Holes C0004C and C0004D (Expedition 316 Scientists, 2009).

Site C0010 objectives

Site C0010 will be the second LTBMS installation during NanTroSEIZE (Kopf, Araki, Toczko, and the Expedition 332 Scientists, 2011). The downhole configuration of the observatory includes (1) pressure ports, (2) a volumetric strainmeter, (3) a broadband seismometer, (4) a tiltmeter, (5) three-component geophones, (6) three-component accelerometers, and (7) a thermometer array (Figure **F4**). The set of sensors is designed to collect, as a whole, multiparameter observations in a wide period range from months to 0.01 s and a wide dynamic range covering tectonic and hydrologic events that include responses to local microearthquakes, VLF earthquakes, and the largest potential earthquake slips of the Tonankai plate boundary 6 km below the sensors. The observatory will be linked to the DONET submarine cable observatory network so that measurements can be observed in real time from a shore-based monitoring station, though it will be initially operated by seafloor installed batteries and data recorders, with data recovery by subsequent ROV operations.

As a contingency option in case of unforeseeable problems during installation of the full LTBMS, a Baker-Hughes retrievable bridge plug instrumented with a GeniusPlug will be installed and function as a replacement temporary observatory.

Drilling strategy, operations plan, and downhole measurements

Operations plan

The operations plan and time estimate (Table **T1**) are based on LWD data collected during previous NanTroSEIZE Expedition 319 drilling operations at this site; they will be used to guide the operations described here. The primary operational plan is to conduct operations in one hole at Site C0010 (Figure **F5**).

Hole C0010A

The LTBMS will be set in Unit III, and the strainmeter will be set in the newly drilled and reamed section of the hole (Figure **F5**). To ensure good coupling of the strainmeter to the formation and to eliminate local fluid motion around the seismic sensors and tiltmeter, the sensors will be cemented in the open hole section below the 9⅝ inch casing shoe in Unit III. One pressure port will be installed below the strainmeter to sample pore fluid pressure in the accretionary prism. Above the cemented sensors in the open hole, the 9⅝ inch casing has a screened interval to sample pore fluid pressure from the splay fault in Unit II, below a swellable packer that serves to isolate the monitoring interval from the seafloor. The downhole sensors are digitally connected to the seafloor where power is supplied and data are recovered, whereas pore fluid pressure is transmitted through hydraulic tubing to sensors and data recorders mounted at the seafloor wellhead.

Logging/Downhole measurements strategy

Hole C0010A

Because Hole C0010A was previously drilled with LWD/MWD tools, no logging (other than with basic LWD) is planned for the bottom-hole section of the existing hole (555–656 mbsf).

Sampling and sample coordination

Expedition 365 will only generate shipboard pressure and temperature data and geochemical samples from the retrieved GeniusPlug. No other data or samples will be collected during the expedition, other than the results of sensor system integrity tests from the newly installed LTBMS. Initial data will become available from the LTBMS after the drilling expedition, at the time of (as-yet unscheduled) ROV visits to service the observatory and download data from memory. All shipboard sample and data requests will be coordinated by the Sample Allocation Committee (SAC), with the understanding that the limited data and samples available will require shipboard scientists to collaborate closely. Shipboard and shore-based researchers should also refer to the IODP Sample, Data, and Obligations Policy & Implementation Guidelines at **http://www.iodp.org/program-policies** for additional details about obtaining and using samples.

Sample requests and coordination

Because NanTroSEIZE is a long-term multiexpedition drilling project that includes multiple linked expeditions over several years that share overarching scientific objectives, sampling and coordination of individual samples and data requests are somewhat different than for single expeditions. These differences include the recognition of the role of Specialty Coordinators, unique data sharing opportunities, and a more integrated sample and data request program. The SAC is composed of the expedition Co-Chief Scientists, Expedition Project Manager (EPM), the shipboard curatorial representative, and the IODP curator on shore. Specialty Coordinators provide advice to the SAC, but the SAC is responsible for all decisions. The SAC for the expedition must approve access to data and core/cuttings samples requested during the expedition and during the 1 y moratorium, which starts at the end of the drilling expedition.

Data/Sample sharing

Data sharing across expeditions is normally accommodated through a formal data/sample request; that is, scientists from one expedition can apply as a shore-based scientist for shipboard data/samples from a completed, planned, or ongoing expedition. In this context, all Expedition 365 scientists will be required to submit a request for data/samples from other Integrated Ocean Drilling Program expeditions, including Expeditions 316 and 319 (which cored Holes C0004C and C0004D and logged Hole C0010A, respectively), if they wish to conduct postexpedition research on core materials or LWD data collected during those previous expeditions.

Sample and data requests

All shipboard scientists must submit at least one data or sample request in advance of the drilling expedition. Additional requests also may be submitted before, during, or after the expedition as necessary to acquire samples or data that will help address fundamental questions of Expedition 365 or individual research projects. Sample or data requests may also be submitted by shore-based scientists, but in case of overlap or potential conflict, the shipboard scientists will be given top priority. The initial requests provide the basis for the SAC and Specialty Coordinators to develop an integrated program to meet all of the essential postexpedition research objectives and to avoid unnecessary duplication of effort. The initial plan, of course, will be subject to modification depending upon the actual material/data recovered and on collaborations that may evolve between scientists before and during the expedition(s). Modifications to this plan during the expedition require the approval of the SAC. To provide time for the SAC and Specialty Coordinators to develop a detailed and integrated sampling strategy, data/sample requests are due by 28 February 2016. Shipboard and shore-based scientists should use the Sample/Data Request form (**http://web.iodp.tamu.edu/sdrm**) to submit their requests.

Contingency plans

Contingency operations

Details of possible operational priorities or contingencies will be decided by the Co-Chief Scientists, EPM, and Operations Superintendents according to operational realities on board the ship; however, current preliminary discussion among the NanTroSEIZE PCT includes a limited contingency plan to deploy a replacement SmartPlug or GeniusPlug in Hole C0010A.

Expedition scientists and scientific participants

The current list of participants for Expedition 365 can be found at **http://www.jamstec.go.jp/chikyu/e/chikyuexp**.

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Table T1. Expedition 365 Hole C0010A operations and time estimates. DP = dynamic positioning. LCA = low-current area. RIH = run in hole, POOH = pull out of hole. CSG = casing, BHA = bottom-hole assembly, F/C = float collar, CMT = cement, TBG = tubing. **Download table in .csv format.**

Operation	Hole size (inch)	Depth (mbsf)	Drilling interval (m)	Days (days)	Subtotal (days)	Total (days)
Seabed depth: 2552.2 (m DRF)						
Port call and transit						
Port call in Shimizu				3.0		
Sail from Shimizu port to Site C0010				1.0	4.0	4.0
Site preparation						
Wellhead/Seabed survey and deploy 4 transponders and DP calibration				1.0		
Recover corrosion cap; move vessel to LCA				1.0	2.0	6.0
Retrieve casing packer with GeniusPlug						
Make up packer retrieving/running assembly and RIH at LCA				1.0		
Drifting to the site; reenter hole and RIH				1.0		
Unseat packer and POOH to above seabed				1.0		
Drifting to LCA and continue POOH				1.0	4.0	10.0
Drill 8-1/2 inch × 9-7/8 inch hole below 9-5/8 inch CSG						
Rig up guide horn				0.5		
Make up drilling BHA while drifting to the site; reenter hole and RIH to F/C		518.9		1.0		
Drill out CMT and drill 8-1/2 inch × 9-7/8 inch; underream hole from 544.3 to 650 mbsf (105.7 m)	9-7/8 8-1/2	650.0 656.0	105.7 111.7	1.0		
Spot gel support fluid; POOH to above seabed; continue POOH while drifting to LCA				1.0	3.5	13.5
9-5/8 inch CSG scraping						
Make up 9-5/8 inch scraper assembly and RIH while drifting to the site; reenter hole and RIH to 380 mbsf (about 10 m above screen top)				1.0		
POOH to above seabed; continue POOH while drifting to LCA				1.0		
Rig down guide horn				0.5	2.5	16.0
Completion						
Preparation; make up LTBMS assembly and run 3-1/2 inch TBG				6.0		
Drifting to the site				2.0		
Reenter hole and RIH; land CORK onto wellhead; cementing				1.0		
POOH running tool assembly while drifting				1.0	10.0	26.0
Recover transponders						
Test pressure logger; recover transponders				1.0	1.0	27.0
Transit						
Sail from the site to Shimizu port				1.0	1.0	28.0
Contingency						
Mechanical down time (operation time × 5%)				1.0		
Wait on weather (2 times × 2 days)				4.0	5.0	33.0
					Total days:	33.0

Figure F1. Map of NanTroSEIZE region. Red circle = Expedition 365 site, white circles = other NanTroSEIZE sites. Black outline = region with 3-D seismic data, yellow arrows = estimated far-field vectors between Philippine Sea plate and Japan (Seno et al., 1993; Heki, 2007), stars = epicenter locations of 1944 and 1946 tsunamigenic earthquakes.

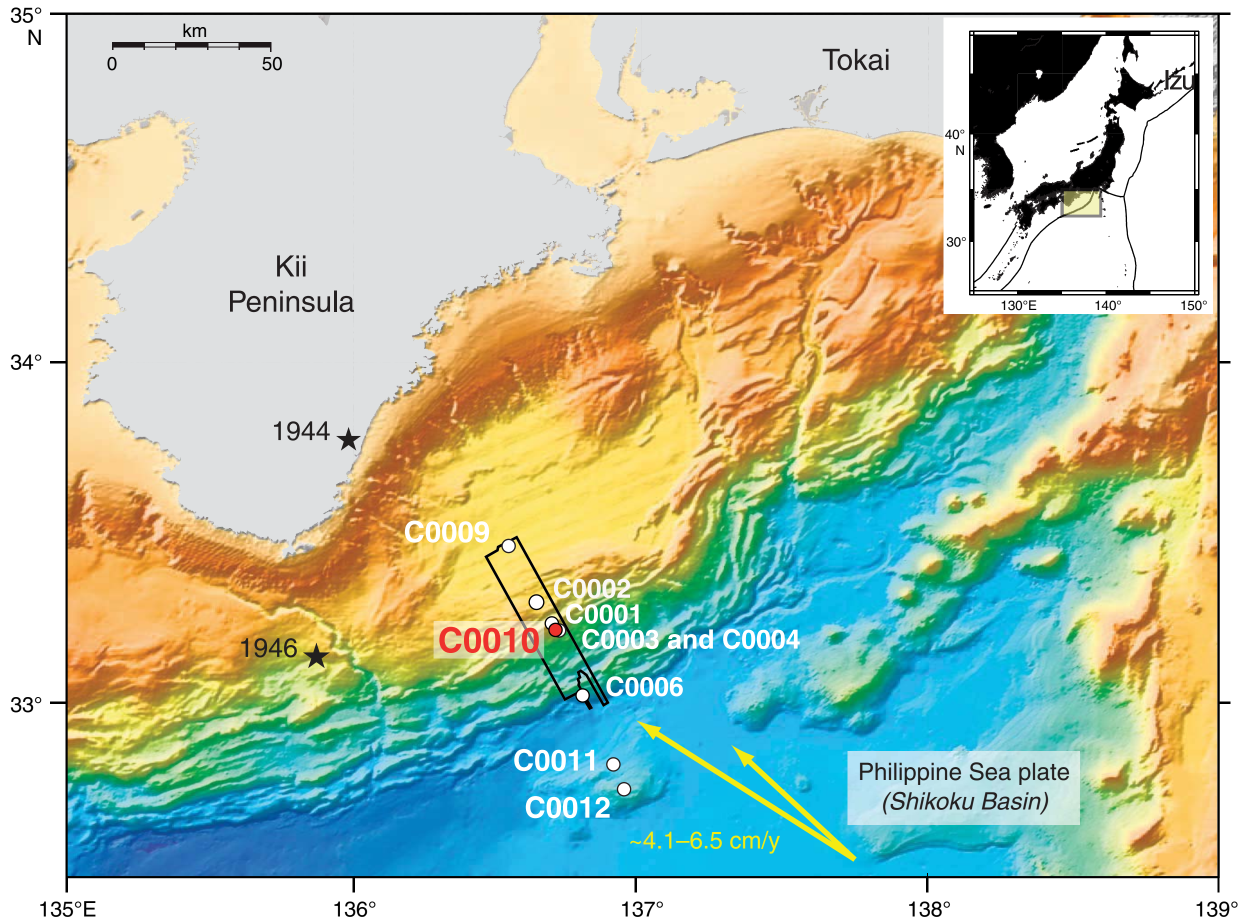


Figure F2. A. In-line (IL) 2529 extracted from 3-D seismic volume, showing the relationship between Hole C0010A to other NanTroSEIZE sites, especially Sites C0002, C0004, and C0006. PSP = Philippine Sea plate. B. Close-up seismic in-line (IL 2488) image of Hole C0010A. C. Cross line (XL) seismic image of Hole C0010A, with location of Hole C0004D superimposed.

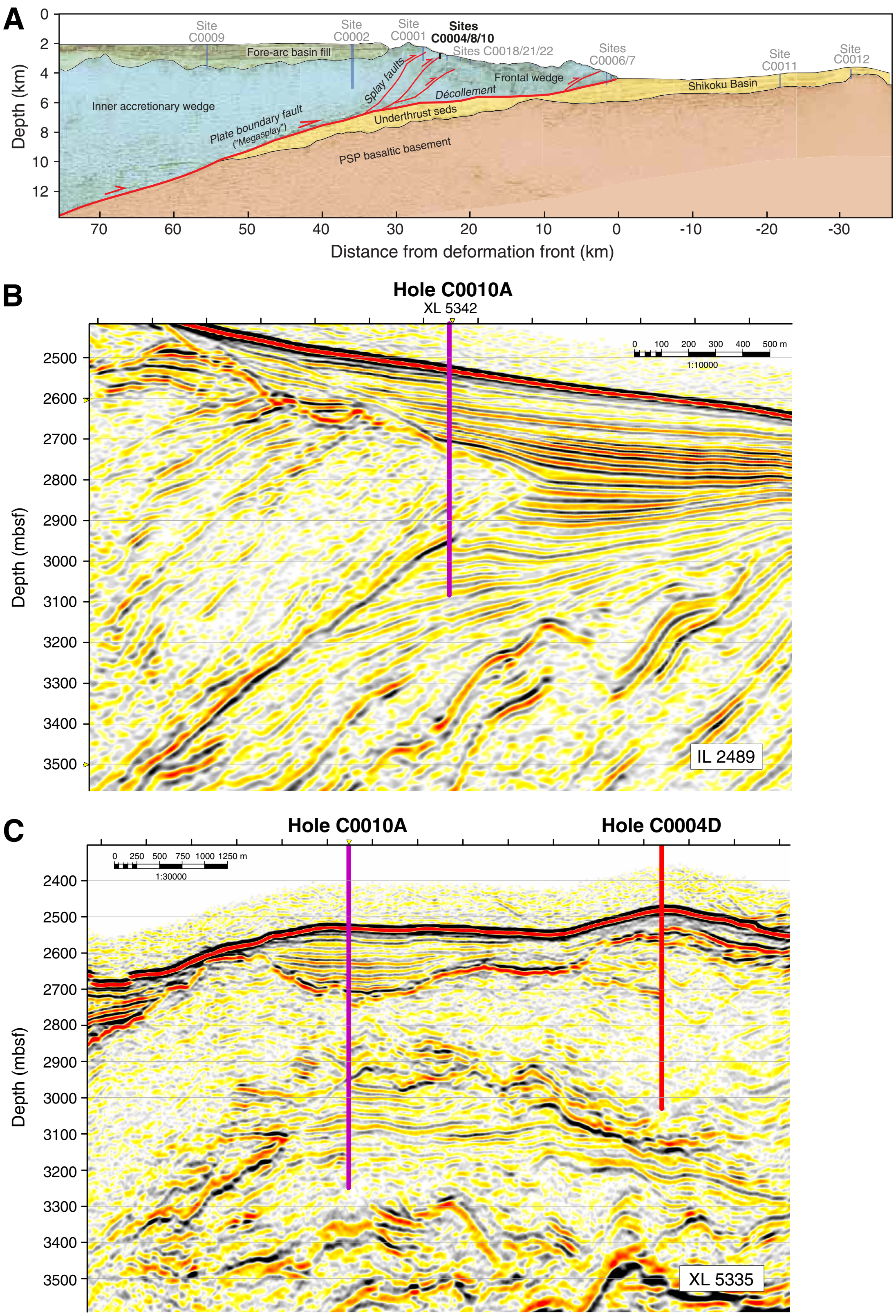


Figure F3. Schematic diagrams of (A) SmartPlug and (B) GeniusPlug OsmoSampler extension, Site C0010. MTL = miniature temperature logger, RTC-PPC = real-time clock pressure period counter.

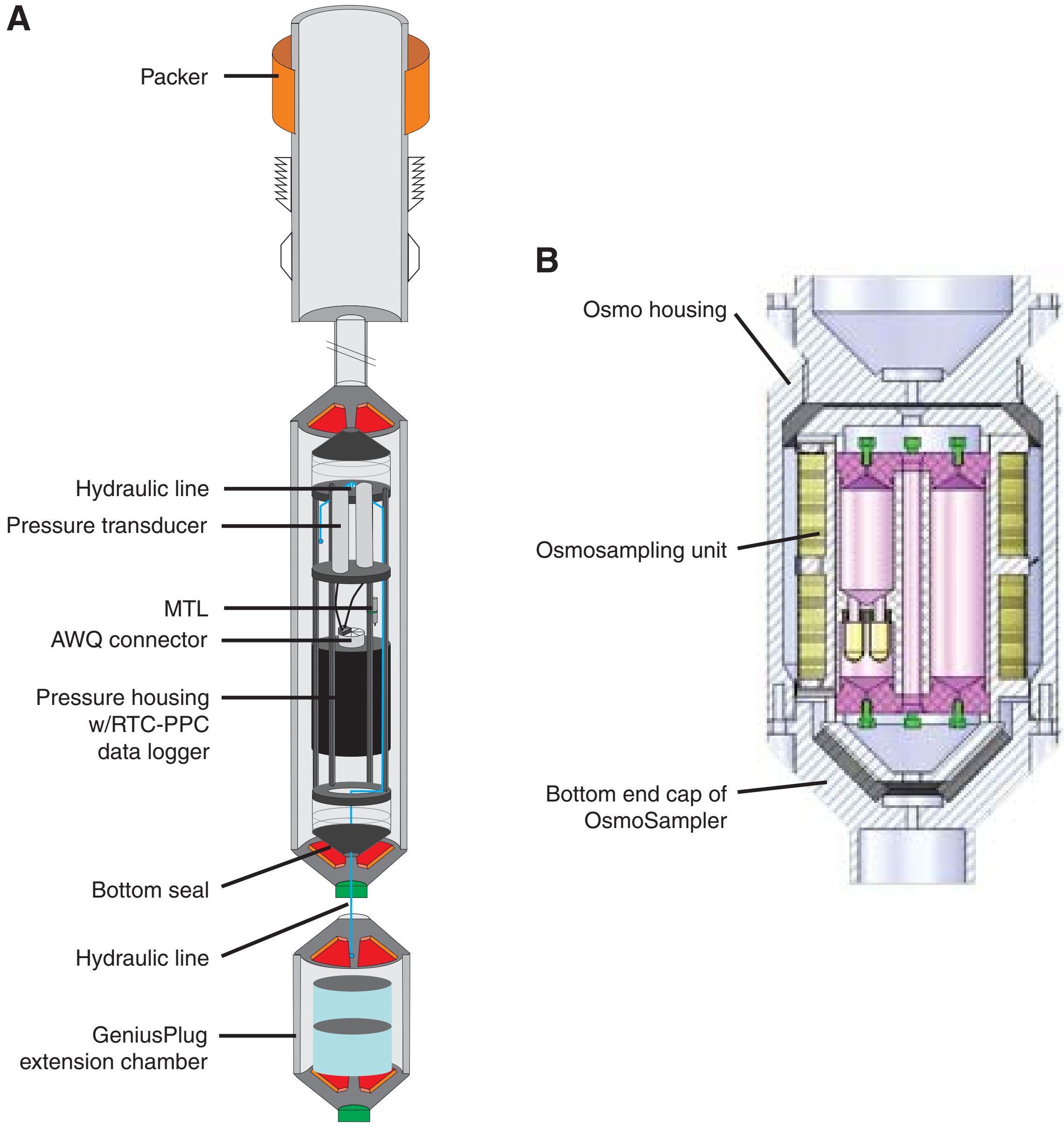


Figure F4. A–E. Diagram and images of LTBMS sensor layout, based on the system installed in Hole C0002G, showing the position of various sensors.

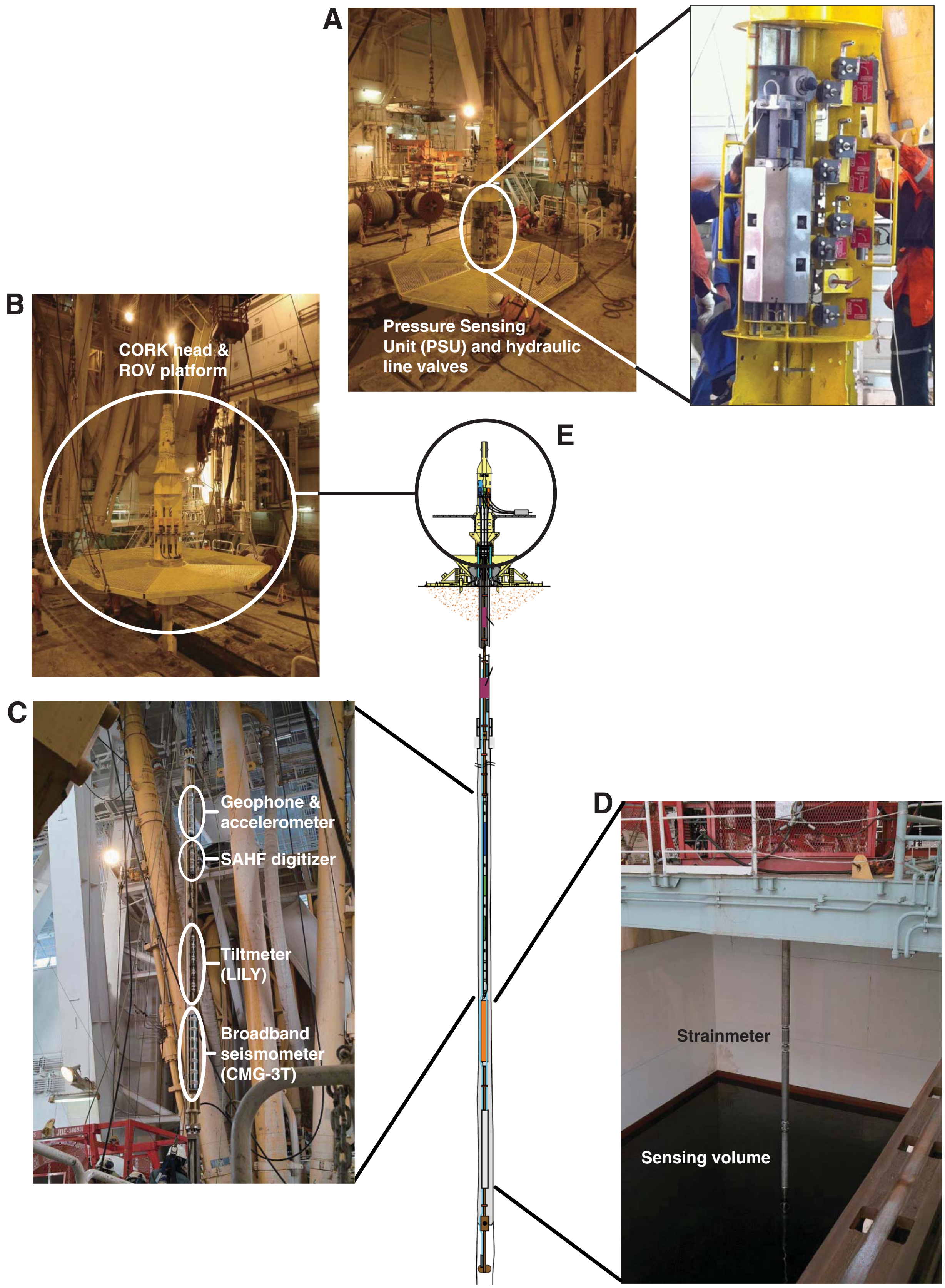
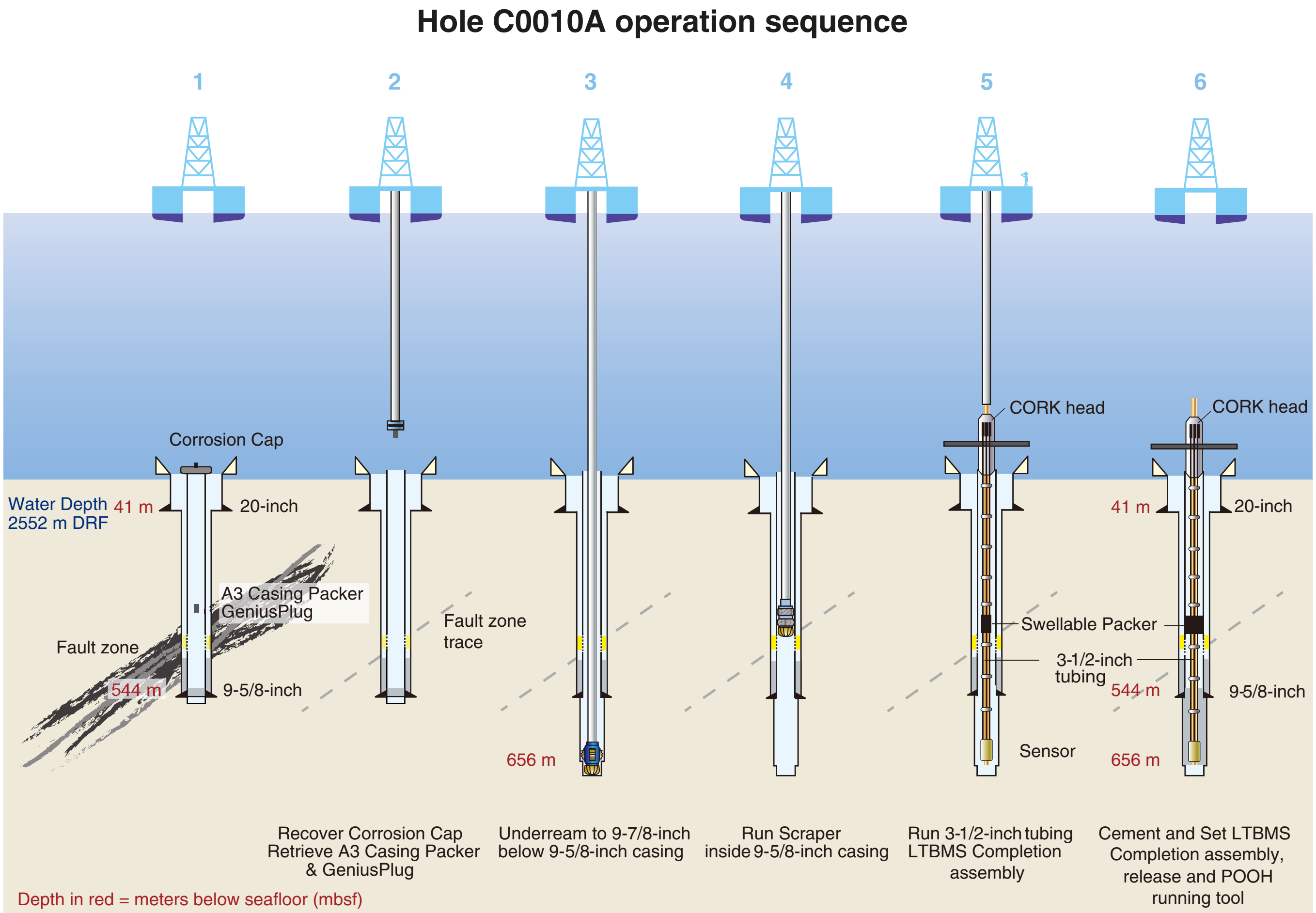


Figure F5. Diagram showing operational stages planned for GeniusPlug recovery and LTBMS installation, Hole C0010A. POOH = pull out of hole.



Site summary

Hole C0010A

Priority:	Primary: *Chikyu* Expedition 365 (riserless)
Position:	32°12.5981′N, 136°41.1924′E
Water depth (m):	2552
Target drilling depth (mbsf):	656
Approved maximum penetration (mbsf):	700
Survey coverage:	Extensive survey data from 3-D seismic data: • In-line 2489 • Cross line 5342
Objective:	Recover GeniusPlug and drill extension for LTBMS deployment
Drilling, coring, and downhole measurement program:	• Drill out hole to TD • Deploy LTBMS permanent observatory
Anticipated lithology:	Hemipelagic mud with turbidite sand, sedimentary breccia, and hemipelagic mudstone