Integrated Ocean Drilling Program Expedition 319 Scientific Prospectus

NanTroSEIZE Stage 2: NanTroSEIZE riser/riserless observatory

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This IODP *Scientific Prospectus* is based on precruise Science Advisory Structure panel discussions and scientific input from the designated Co-Chief Scientists on behalf of the drilling proponents. During the course of the cruise, actual site operations may indicate to the Co-Chief Scientists, the Expedition Project Manager, and the Operations Superintendent that it would be scientifically or operationally advantageous to amend the plan detailed in this prospectus. It should be understood that any proposed changes to the science deliverables outlined in the plan presented here are contingent upon the approval of the CDEX Science Operator Science Manager in consultation with IODP-MI.

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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. The primary goals for Integrated Ocean Drilling Program (IODP) Expedition 319 are riser drilling, analyses of cuttings and limited cores, logging, and casing at proposed Site NT2-11B (or alternate proposed Site NT2-11A) and riserless drilling, logging while drilling (LWD), and casing at proposed Site NT2-01J (or alternate proposed Site NT2-01K). Operations at both sites will include placing a wellhead and drilling and casing to the target depth in preparation for installation of monitoring equipment planned for future expeditions. This *Scientific Prospectus* outlines the scientific rationale, objectives, and operational plans for drilling these two sites.

Proposed Site NT2-11B is a riser drilling site located in the Kumano forearc basin in the upper plate above the seismogenic and presumed locked portion of the plate boundary thrust system. During this expedition, proposed Site NT2-11B will be drilled to 1600 meters below seafloor (mbsf) to (1) determine the composition, physical properties, and stratigraphy of the basin sediments, (2) conduct downhole measurements to determine stress magnitude and orientation and pore pressure magnitudes, (3) install casing in preparation for a riser observatory, and (4) acquire data from a two-ship vertical seismic profile experiment to characterize the rock volume surrounding and below the borehole, including the subduction thrust at a depth of ~10 km. The observatory (planned for installation in 2010 or 2011) will monitor seismicity, volumetric strain, tilt, pore pressure, and temperature, with the goals of characterizing strain accumulation and release, microseismicity, hydrologic transients associated with strain events, and ambient pore pressure and temperature. Proposed Site NT2-01J is a riserless drilling site located 3.5 km along strike of previously drilled and cored IODP Site C0004 and will penetrate a major splay fault ("megasplay") at ~410 mbsf. The objectives at this site are to (1) collect measurement while drilling (MWD) and LWD data that will complement LWD and core data collected during IODP Expeditions 314 and 316 at Site C0004, (2) install casing in preparation for installation of an observatory (planned for 2010 or 2011) that will cross the fault

zone and extend into the footwall, and (3) install a temporary instrument package that will monitor pore pressure and temperature within a screened interval spanning the shallow megasplay fault zone. The temporary instrument package will provide continuous monitoring in the time between drilling of the site and final observatory installation (planned for 2010 or 2011). The observatory planned for 2010 or 2011 at this site will monitor seismicity, volumetric strain, tilt, pore pressure, and temperature. Together with the observatory at proposed Site NT2-11B, this will form the beginning of a distributed observatory network that spans the region above the aseismic–seismic transition on the plate boundary at depth.

Contingency plans for Expedition 319 include: (1) drilling, casing, and installing a temporary instrument package at IODP Site C0002 (former proposed Site NT3-01) in the outer more seaward portion of the Kumano Basin similar to the package planned for proposed Site NT2-01J and (2) coring at proposed Site NT1-01A (located seaward of the Nankai Trough on the incoming Philippine Sea plate).

Schedule for Expedition 319

The operations schedule for Integrated Ocean Drilling Program (IODP) Expedition 319 is derived from original IODP drilling proposals 603-CDP3, 603A-Full2, 603B-Full2, 603C-Full, and 603D-Full2 (available for download at **www.iodp.org/NanTroSEIZE**).

Following ranking by the IODP Scientific Advisory Structure, the IODP Operations Task Force charged the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) Project Management Team (NT-PMT) with formulating a strategy for achieving the overall scientific objectives outlined in these proposals. The overarching goals and multistage implementation strategy are described in Tobin and Kinoshita (2006a, 2006b). For "Phase 2" of the NanTroSEIZE project described in proposals 603B and 603D, the IODP Operations Committee scheduled one Stage 1 expedition and one Stage 2 expedition on D/V *Chikyu,* operating under contract with the Japanese Implementing Organization, Center for Deep Earth Exploration (CDEX) (**www.jamstec.go.jp/chikyu/eng/Expedition/index.html**).

Expedition 319 is the first expedition of Stage 2 and is currently scheduled to begin directly following the completion of shakedown for the new drill-rig operators, Mantle Quest, Japan. At the time of publication, the ship schedule has not been completely finalized and readers should refer to **www.jamstec.go.jp/chikyu/eng/**

CHIKYU/index.html for detailed schedules, updates, and information regarding the operation and layout of *Chikyu*. A total of 114 days including 27 days of contingency time will be available for the drilling, coring, logging, and casing operations during Expedition 319, as described in this prospectus.

Introduction

Overview of the NanTroSEIZE drilling project

Subduction zones account for 90% of global seismic moment release, generating damaging earthquakes and tsunamis with potentially disastrous effects on heavily populated coastal areas (e.g., Lay et al., 2005). 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, and measurement of in situ conditions 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 (SAFOD) (Hickman et al., 2004), the Taiwan-Chelungpu Drilling Project (Ma, 2005), and IODP NanTroSEIZE drilling (Tobin and Kinoshita, 2006a, 2006b).

The NanTroSEIZE project is a multiexpedition, multistage IODP drilling program focused on understanding the mechanics of seismogenesis and rupture propagation along subduction plate boundary faults. The drilling program includes a coordinated effort to sample and instrument the plate boundary system at several locations offshore the Kii Peninsula (Tobin and Kinoshita, 2006a) (Figs. **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 and 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 a combination of riser and riserless drilling, long-term observatories, and associated geophysical, laboratory, and numerical modeling efforts. The following hypotheses are paraphrased from the original IODP 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 great earthquakes of ~M 8.0+ (Ruff and Kanamori, 1983). Although the causative mechanisms are not well understood (e.g., Byrne et al., 1988; Moore and Saffer, 2001; Saffer and Marone, 2003), 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). At Nankai, 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 M 8.2 earthquake (Fig. **F2A**). Several lines of evidence indicate that the megasplay system is active and 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 and the nature and mechanisms of fault slip as a function of depth and time 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—and which bears both on understanding subduction zone megathrust behavior globally and on 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.

In late 2007 through early 2008, IODP Expeditions 314, 315, and 316 were carried out as a unified program of drilling collectively known as NanTroSEIZE Stage 1. A transect of eight sites was selected for riserless drilling to target the frontal thrust region, the midslope megasplay fault region, and the Kumano forearc basin region (Figs. **F1, F2**). Two of these sites are preparatory pilot holes for planned deeper riser drilling operations, whereas the other sites primarily targeted fault zones in the shallow, presumed aseismic portions of the accretionary complex (Kinoshita et al., 2008). Expedition 314 was dedicated to in situ measurement of physical properties and borehole imaging through logging while drilling (LWD) in holes drilled specifically for that purpose. Expedition 315 was devoted to core sampling and downhole temperature measurements at two sites in the hanging wall of the megasplay system: one in the Kumano Basin and the second just seaward of the outer rise. Expedition 316 targeted the frontal thrust and megasplay fault in their shallow, aseismic portions (for more details see Kinoshita et al., 2008; Ashi et al., 2008; Kimura et al., 2008)

NanTroSEIZE Stage 2 is composed of two Expeditions (319 and 322), with the aims of building on the results of Stage 1 and preparing for later observatory installations for long-term monitoring of deformation at the updip limit of the seismogenic zone. Expedition 319 will investigate the properties, structure, and state of stress within the hanging wall above the locked plate boundary at proposed Site NT2-11B and across the shallow megasplay at proposed Site NT2-01J and prepare the boreholes for future installation of observatories. IODP Expedition 322 will sample and characterize the properties of sediments on the subducting Philippine Sea plate ("input sites") as a critical part of investigating the progressive changes in material properties and state hypothesized to control the upper transition from aseismic to seismic slip (hypothesis 1 above; Moore and Saffer, 2001). Expedition 319, described in detail in this prospectus, includes a coordinated riser/riserless drilling plan to drill two sites: a riser site in the Kumano Basin above the portion of the plate boundary thrust that slips coseismically (proposed Site NT2-11B) and a riserless site into the shallow megasplay fault near its updip terminus (proposed Site NT2-01J). Riser drilling and casing at proposed Site NT2-11B are planned for the first part of Stage 2 followed by riserless drilling and casing at proposed Site NT2-01J. Both sites have also been selected for future installation of long-term observatories. A contingency site (C0002) may be drilled and cased in preparation for a second riserless observatory, time permitting. The second Stage 2 expedition, Expedition 322, will complete drilling and coring at the subduction input sites (Saito et al., in press).

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 mm/y (Seno et al., 1993). 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 3000 or more years are well documented in historical and archeological records (e.g., Ando, 1975). The Nankai Trough has been selected as a focus site for studies of seismogenesis by both IODP and the U.S. MARGINS initiative, based on the wealth of geological and geophysical data available, a long historical record of great (M > 8.0) earthquakes, and the direct societal relevance of understanding tsunamis and earthquakes that have had, and will have, great impact on nearby heavily populated coastal areas.

Subduction zones like the Nankai Trough, at which great earthquakes (M > 8.0) occur, are especially favorable for study because the entire downdip width of the seismogenic zone ruptures in each event, suggesting that the zone of coseismic rupture in future large earthquakes may be more predictable than for smaller earthquakes. The Nankai Trough region has a 1300 y historical record of recurring great earthquakes that are typically tsunamigenic, including the 1944 Tonankai M 8.2 and 1946 Nankaido M 8.3 earthquakes (Ando, 1975; Hori et al., 2004). The rupture area and zone of tsunami generation for the 1944 event are now reasonably well understood and includes Stage 1 and Stage 2 hanging wall drill sites (Ichinose et al., 2003; Baba et al., 2005). Land-based geodetic studies suggest that the plate boundary thrust is currently strongly locked (Miyazaki and Heki, 2001), and the relatively low level of microseismicity near the updip limits of the 1940s earthquakes implies significant interseismic strain accumulation on the megathrust (Obana et al., 2001). However, recent observations of very low frequency earthquakes within or just below the accretionary prism in the drilling area demonstrate that interseismic strain is not confined to slow elastic strain accumulation (Obara and Ito, 2005). Slow slip phenomena including episodic slow slip events and nonvolcanic tremor are also widely known to occur in the downdip part of the rupture zone (Ito et al., 2007). Weak seismicity is also observed in the mantle of the subducting Philippine Sea plate and below the rupture zone (Obana et al., 2005). Seaward of the subduction zone, deformation of the incoming ocean crust is suggested by microearthquakes as documented by ocean bottom seismographic 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 Tonankai M 8.2 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 past coseismic rupture events in this region have clearly extended to shallow enough depth to be within the reach of current drilling technologies (Ichinose et al., 2003; Baba and Cummins, 2005), and an updip zone of large slip has been identified and targeted (Fig. **F1B, F2A**). 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, ocean bottom seismometer 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 Deep Sea Drilling Project and Ocean Drilling Program [ODP] drilling) where both local stratigraphic variation associated with basement topography and anomalously high heat flow have been documented (Moore, Taira, Klaus, et al., 2001; Moore et al., 2005). 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 ~6000 m beneath the seafloor (Nakanishi et al., 2002).

Seismic studies/site survey data

A significant volume of site survey data has been collected in the drilling area over many years, including multiple generations of two-dimensional 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, and swath bathymetry and submersible and ROV dive studies (Ashi et al., 2002). In 2006, Japan and the United States conducted a joint three-dimensional (3-D) seismic reflection survey over a ~11 km × 55 km area, acquired by PGS Geophysical, an industry service company. This 3-D data volume is the first deep-penetration, fully 3-D marine survey ever acquired for basic research purposes and has been used to refine selection of drill sites and targets in the complex megasplay fault region, define the 3-D regional structure and seismic stratigraphy, analyze physical properties of the subsurface through seismic attribute studies, and assess drilling safety (Moore et al., 2007; Moore et al., 2009). These high-resolution, 3-D data will be used in conjunction with physical properties and geophysical data obtained from core analyses and both wireline and LWD logging to allow extensive and high-resolution integration of core, logs, and seismic data.

Long-term observatories

In future IODP expeditions, a series of long-term borehole observatories will be installed into the three holes potentially drilled during Expedition 319 at proposed Sites NT2-11B and NT2-01J and IODP Site C0002 (contingency site). The three boreholes are located within and above regions of contrasting behavior of the megasplay fault zone and plate boundary as a whole (i.e., a site ~6–7 km above the "locked" seismogenic plate boundary [proposed Site NT2-11B], a site above the updip edge of the locked zone [Site C0002], and a shallow site in the megasplay fault zone and footwall where slip is presumed to be aseismic [proposed Site NT2-01J]). These observatories have the potential of capturing seismic activity, slow slip behavior, and possibly interseismic strain accumulation on the plate boundary and megasplay faults across a range of pressure, temperature, and kinematic conditions.

Currently, the planned observation system for the boreholes 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 very low frequency earthquakes, hydrologic transients associated with strain events, ambient pore pressure, and temperature. To ensure the long-term and continuous monitoring necessary to capture events occurring over a wide range of timescales, these borehole observatories will be connected to submarine cabled observation network called Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) (**www.jamstec.go.jp/jamstec-e/maritec/donet**), which will be constructed in and around the drilling target area.

Scientific objectives

Operations at proposed Site NT2-11B will drill, sample, and case the hole above the locked portion of the coseismically active plate boundary thrust. These operations will also provide preparation for later observatory placement, which will monitor deformation, seismicity, pore pressure, and temperature (Figs. **F3, F4**). The fundamental scientific objectives of Expedition 319 include:

1. Documenting the lithology, structural geology, physical properties, and composition of the upper 1600 m of basin fill sediments in the hanging wall of the plate boundary fault;
2. Collecting core at or near the depth of potential observatory installation to confirm stratigraphic and structural observations and interpretations made from geophysical techniques, and to obtain samples for shore-based geotechnical and mechanical analyses; and
3. Conducting downhole tests to measure in situ pore pressures and stress states.

At proposed Site NT2-01J, drilling will penetrate the megasplay fault at 410 meters below seafloor (mbsf) and the footwall to a total depth (TD) of 525 mbsf (Figs. **F5, F6**). The major scientific objectives at proposed Site NT2-01J include:

1. Characterizing the lithology and structural geology of the hanging wall, fault zone, and footwall using logging data;
2. Defining physical properties in the hanging wall and footwall of the shallow part of the megasplay; and
3. Installing a temporary monitoring package in a screened interval, which is designed to monitor pore pressure and temperature within the fault zone.

The overall engineering objectives at proposed Sites NT2-11B and NT2-01J are to set the wellhead, case and cement the sites in preparation for future observatory deployment, and install temporary monitoring instruments attached to a bridge plug at proposed Site NT2-01J.

Operations plan/drilling strategy

To meet the scientific and engineering objectives, primary operations at proposed Sites NT2-11B and NT2-01J will be to drill and case to TD, as shown in Figures **F7** and **F8.** At proposed Site NT2-11B, cuttings will be collected and analyzed during riser drilling from 700 mbsf (bottom of 20 inch casing) to ~1600 mbsf. Wireline coring (~90 m) will be conducted at proposed Site NT2-11B between 1510–1600 mbsf using a rotary core barrel (RCB) to obtain the highest quality and most complete core samples immediately above a potential target interval for observatory instruments between 1510 and 1600 mbsf (Fig. F7). Operations at proposed Site NT2-01J will include measurement while drilling (MWD) and LWD to TD of 525 mbsf, casing to TD, and installation of a temporary pore pressure and temperature monitoring system (Fig. F8).

Operations plan

The operations plan and time estimate (Table T1) are based on formations and depths inferred from seismic and regional geological interpretations, combined with data from previous drilling operations at nearby sites. The MWD/LWD holes drilled at each site will be referred to as Hole A in all cases. We will use these operations and data to guide the operations described below. Our expedition plans are to conduct operations in one hole at proposed Site NT2-11B (Fig. F7) and one hole at proposed Site NT2-01J (Fig. F8). An abbreviated list of primary sites, holes, drilling depths, and contingency plans can be found in **"Site summaries."**

Proposed Site NT2-11B

We will run and jet-in a 36 inch conductor casing to 60 mbsf. Following this, the wellhead and blowout preventer will be set at the seafloor, and a 26 inch hole will be drilled to 700 mbsf with MWD (Fig. F7). The upper 700 m will be cased with 20 inch casing, then cemented. We will then drill a 12¼ inch hole from 700 to 1510 mbsf, and then RCB core from 1510 to 1600 mbsf. After coring, we will run three sets of wireline logs from 700–1600 mbsf (described in detail in later sections of this prospectus). After wireline logging the hole will be opened to 17 inches and cased to TD with 13⅜ inch casing. After cementing the casing, a cement bond log (CBL) will be run inside the casing. Following the CBL, we will run a vertical seismic profile (VSP) experiment. This will include a zero-offset VSP, as well as a two-ship experiment, pending coordination with a second (shooting) vessel. The VSP is planned for 2 days but may include additional time depending on operational progress and drilling schedule. Following the VSP, the wellhead will be set on the surface.

As a contingency plan at proposed Site NT2-11B, installation of a temperature monitoring system is planned (Fig. F9). This consists of up to 10 stand-alone self-recording temperature loggers in a 100 m long 9⅝ inch outside diameter (OD) casing hung below the tubing hanger. The main objective is to monitor any intrahole advection that will affect the performance of midhole observatory sensors to be installed in the future. If installed, this temperature monitoring system will be recovered in ~2 y when

Chikyu revisits this hole to install the borehole observatory. In either case, the cased hole will then be capped with a corrosion cap.

Proposed Site NT2-01J

We will begin by jetting-in a 20 inch conductor to 36 mbsf. The hole will then be drilled with MWD/LWD to TD at 525 m and cased to TD. The casing string will include two screened casing joints that will span the fault zone at ~410 mbsf. After cementing, a "dummy run" to evaluate future observatory installation operations will be conducted, followed by a wireline temperature log inside the casing to identify the top of cement. The hole will be suspended by installing a retrievable casing packer at ~390 mbsf that is modified to include an instrument package below, and by setting a corrosion cap.

Logging/downhole measurements strategy

Proposed Site NT2-11B

During drilling of proposed Site NT2-11B, MWD tools will be run between 700–1600 mbsf to monitor drilling conditions and define major lithologic changes in real time. The MWD tool suite will include annular pressure while drilling (APWD), weight on bit (WOB), torque, hole inclination, and gamma ray. The Power-V tool will also be run during drilling to maintain hole inclination at <3°. In addition, if budget permits, the geoVISION LWD tool will be added to this suite to obtain LWD azimuthal resistivity data and borehole resistivity images, in order to further define stratigraphic boundaries and to characterize bedding, minor faults, and any breakouts or tensile fractures induced by drilling (Fig. **F10**).

Planned wireline logging operations at proposed Site NT2-11B include three runs between 700 and 1600 mbsf prior to installing 13⅜ inch casing (Fig. **F8**). The first logging run will include resistivity measurement using the Formation MicroImaging (FMI) tool, sonic velocity measurements with the Sonic Scanner (a first for scientific drilling), a six-arm caliper, and mud temperature measurement with the Environmental Measurement Sonde (EMS) tools (Fig. **F10**). The goals of this logging run are to obtain information about (1) lithology, facies boundaries defined by log characteristics, and bedding dips; (2) structural geology and any borehole breakouts or tensile fractures that may provide information on in situ stress conditions; (3) rock physical properties and data for core-log-seismic integration from sonic velocity logs; and

(4) hole conditions from caliper measurement. The second run will include the new-generation triple combination Platform Express and EMS tools to measure density, porosity, gamma ray, resistivity, and caliper (Fig. **F10**).

If hole conditions and time permit, a third logging run will employ the Modular Formation Dynamics Tester (MDT) dual packer tool (Fig. **F10**) to measure in situ minimum stress magnitude and pore pressure. The measurement depths and test interval thickness will be defined on board based on results from MWD (and possibly LWD) measurements and the previous wireline logging runs.

Vertical seismic profiling

If time permits, a VSP experiment will be conducted at proposed Site NT2-11B using a Schlumberger Versatile Seismic Imager (VSI) tool, after installation and cementing of the 13⅜ inch casing (Fig. **F7, F11**). The VSI tool consists of an array of separate sensor shuttles, a VSI cartridge, and a telemetry module. Each sensor shuttle consists of triaxial (three component) geophone accelerometers, a hydrophone, and a locking arm to connect the sensors to provide mechanical coupling to the casing interior. The planned VSP experiment includes two components: a zero-offset experiment, and a two-ship offset ("walkaway") experiment.

The zero-offset VSP experiment will provide interval velocities between the seafloor and TD, which will be used in combination with wireline logging data to gain information about rock physical properties in the upper 1600 m and to tie the borehole data to the 3-D seismic data. The two-ship experiment will be coordinated with a separate shooting vessel to collect data at relatively large offsets in the range up to 40 km, in lines both parallel and perpendicular to the dip of subducting plate.

The offset VSP experiment will allow sampling of reflected seismic waves from beneath the borehole, including those from the plate boundary fault(s), the sediment/basalt interface, and possibly the Mohorovicic discontinuity of the subducting oceanic plate. A key advantage of the VSP experiment compared with existing high-quality 3-D seismic reflection data is that the geometry of the experiment results in significantly less attenuation and reduces the effects from anisotropy from the overlying sediment and ~2000 m of water. Proposed Site NT2-11B is located ~10 km directly above the updip edge of the inferred locked portion of the plate boundary, and the wide range of planned shooting offsets will provide high-resolution data to define the detailed seismic characteristics and physical properties of the rock volume below the borehole containing the plate boundary fault zone.

The VSP data will be treated as a shipboard data set, which will be fully accessible and shared among the Expedition 319 shipboard party and the third party VSP principal investigator (PI) group that is coordinating the experiment. Similarly, we expect that the third party VSP PI group will be granted access to relevant shipboard data, upon request. We anticipate close collaboration between the shipboard party and the VSP group, with the overall goal of being as inclusive as possible and maximizing the scientific return from data sets that are generated by the experiment.

Proposed Site NT2-01J

We plan to conduct LWD and MWD measurements from 36 mbsf (base of 20 inch casing) to TD at 525 mbsf (Fig. **F8**). At proposed Site NT2-01J, the primary scientific goals of downhole logging will be to (1) define the target interval for casing screens for pore pressure and temperature monitoring and (2) collect data on bedding and fault orientations, fault and fracture density, borehole breakouts if they occur, formation resistivity, gamma ray response, and drilling parameters, complementing data from the previously drilled Site C0004 (located 3.5 km southwest along strike from proposed Site NT2-01J) that also penetrated the shallow megasplay. Because proposed Site NT2-01J is in close proximity to Site C0004 (Kinoshita, et al., 2008; Kimura et al., 2008), we do not plan to core or conduct detailed wireline logging operations. However, we anticipate that the exact depths of the target intervals and the fault zone architecture will differ between the two sites. As at proposed Site NT2-11B, the LWD tool suite will include azimuthal resistivity and gamma ray (geoVISION) and the MWD tool string will include APWD, WOB, torque, and hole inclination (Fig. **F10**).

Sensor dummy run test

After the casing operations at proposed Site NT2-1J, a test will be conducted to simulate the procedure of installing borehole sensors in the hole as part of the preparation for fabricating long-term borehole observatories for installation during future NanTroSEIZE expeditions. This test has two main objectives: (1) to evaluate environmental conditions, such as shock acceleration and vibration, which borehole sensors will encounter during installation to the bottom of the hole; and (2) to confirm sensor installation operational procedures, such as onboard assembly of the sensor tree, ship maneuvers to reenter the sensor tree, and lowering the sensor into the hole.

The sensor tree for the test is illustrated in Figure **F12.** The tree will be attached to the end of the drill pipe and reenter the riserless hole. The tree consists, from the bottom up, of 3½ inch tubing; a borehole strainmeter; a multi-instrument carrier that houses a self-recording accelerometer, tiltmeter, and other sensors; and 3½ inch tubing to be attached to the drill pipe. The tree is similar to the structure of the bottom section of the planned observatories, with the exception that no cables or hydraulic lines are attached, and we will not use the same total length of tubing and circulation obviation retrofit kit (CORK) head that will hang down from the casing hanger. Vibration and shock acceleration will be recorded by the self-recording accelerometer and tiltmeter. The strainmeter and seismometer package will be inspected before and after the dummy run to evaluate their performance.

Instrumented retrievable casing packer (temporary monitoring system)

We plan to suspend the hole at proposed Site NT2-01J by installing a mechanically set retrievable packer (Baker A3 Lok-Set) inside the 10⅝ inch casing string, modified to attach a small instrument package (Fig. **F13**). The packer will be set above the screened casing joints, at a planned depth of ~390 mbsf. The instrument package will be threaded to the bottom of the bridge plug and will include a self-contained temperature sensor and data logger, as well as a pressure gauge and data logger package. These instruments will be in hydrologic communication with the fault zone at the screened interval and will monitor formation pore pressure and temperature from the time the bridge plug is set until they are retrieved at the beginning of permanent riserless observatory installation operations.

Sampling and sample coordination

Expedition 319, for the first time in ODP or IODP, will be sampling cuttings from riser drilling as well as a limited number of sediment cores. As a result, sampling and sample coordination will involve a new combination of shipboard analysis, sample collection, and sample archiving that, although outlined in the follow paragraphs, will probably evolve as samples are processed during the expedition. Sampling of retrieved cores will follow traditional IODP policy, including discrete samples, whole-round samples (both individual requests and "community whole rounds"), and sample clusters (see additional explanation of community whole rounds and sample clusters in **"Sampling sediment cores"**). In contrast, sampling cuttings from riser drilling will follow a preliminary set of guidelines developed, in part, from experience transferred from the oil industry and from the SAFOD drilling program. The core and cuttings sampling strategy was developed by the NT-PMT in consultation with the Sample Allocation Committee (SAC) (see **"Sample requests and coordination"**) to best meet the drilling project's objectives and the needs of the science party. A short review of core sampling and archiving is provided below followed by a more detailed discussion of sampling and archiving of cuttings. Shipboard and shore-based researchers should also refer to the IODP Sample, Data, and Obligations Policy (**www.iodp.org/program-policies**).

Sampling sediment cores

Cores are typically split into a "working half" and "archive half" with the working half being available for sampling by shipboard and shore-based scientists. Although the archive half is also available for sampling in certain circumstances, it is primarily designed to preserve retrieved material while providing flexibility and broader access to important material postcruise. Samples of whole-round cores can also be requested following IODP policy.

The unique, multiexpedition nature of NanTroSEIZE has also required the modification of normal IODP sampling policy and routines in sampling sediment cores. Specifically, these include: (1) community whole-round cores that are archived (at the Kochi Core Repository) for postcruise distribution and (2) sample clusters taken as a suite of basic scientific measurements collected onboard from a much smaller (1–2 cm thick) whole-round core. These basic measurements consist of pore water, carbonate, moisture and density, and bulk X-ray diffraction (XRD). Community whole-round cores and sample clusters are typically collected from each section.

Community whole-round core samples

As usual, individual scientists will collect whole-round samples for shipboard analyses and their postcruise research. In addition, however, we intend to collect "community" archive whole-round samples, which will augment and/or provide redundancy for those requested by shipboard scientists. The goal is to preserve samples for a wide range of overall science objectives after the expedition and over the duration of the NanTroSEIZE project. Community whole-round cores are typically collected from each core.

Sample clusters

To ensure achievement of overall NanTroSEIZE scientific objectives and maximize the ability to correlate different shipboard data sets, it will be essential to co-locate suites of essential data types (pore water, calcium carbonate, moisture and density, bulk XRD, and bulk chemistry). This will be done with appropriate and consistent sample spacing throughout each site's stratigraphic succession. Sample clusters are normally collected from each section.

Sampling and archiving drill cuttings

Unwashed drill cuttings are delivered continuously to the shale shaker where they are sampled by the "Sample Catcher" at a frequency equivalent to every 5 m of drilling penetration (Fig. **F14A**). The Sample Catcher then splits the cuttings into two splits–one for the Mud Logger and the second for the IODP scientific analysis. The IODP cuttings sample has a volume of ~1.5 L, depending on the volume of total sample requests, and is transferred to the Laboratory Roof Deck (by a MQJ "Roustabout"), where it is again split into two portions: a 400 cm^3 portion for archiving (the "archive portion") and a 1000 cm^3 portion for analysis and sampling (the "working portion") (Fig. **F14A, F14B**). The working portion is available for scientific sampling and analysis at any stage of the cleaning, sieving, and preliminary analysis shown in Figure **F14B** (potential sampling intervals are noted with diamonds). A portion of the archived cuttings (designated as a "temporary archive") is also available for sampling and analysis after the moratorium and approval of the SAC. Shipboard analysis of the working portion normally includes:

- gamma ray,
- moisture and density,
- lithologic descriptions (through smear slides and thin sections),
- XRD and X-ray fluorescence analyses,
- magnetic susceptibility,
- total carbonate (using carbonate analyzer), and
- total carbon and nitrogen (using CHNS/O elemental analyzer).

Sample requests and coordination

Because NanTroSEIZE is a long-term multiexpedition drilling project that includes several 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 Specialty Coordinators, unique data sharing opportunities, and a more integrated sample and data request program. Key aspects of these differences are described below.

Specialty coordinators

Unlike traditional stand-alone ODP/IODP legs and expeditions, unusual amounts of coordination and collaboration must occur among science parties across expeditions and within the framework of overall NanTroSEIZE goals. Specialty Coordinators, in collaboration with Co-Chief Scientists, will be responsible for facilitating collaborations between the participants on the two parts of Expedition 319, as well as identifying research or sampling gaps or collaborations in addition to those planned by shipboard science parties but needed to advance the overall NanTroSEIZE scientific goals. They will also provide technical and scientific guidance to each science party. The NT-PMT has identified six specific research areas that require special effort over the project's duration:

1. Lithology and sedimentary petrology,
2. Structural geology,
3. Geotechnical properties and hydrogeology,
4. Geochemistry,
5. Core-log-seismic integration, and
6. Paleomagnetism and biostratigraphy.

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 or planned expedition. In this context, all Expedition 319 scientists are encouraged to submit a request for data/samples from other IODP expeditions, including Expedition 322, if they are interested in conducting postcruise research that furthers the science objectives of those expeditions. In the case of NanTroSEIZE, it is also possible that drilling or scientific objectives will overlap across two or more expeditions to such an extent that the expeditions will be considered one expedition in terms of shipboard data and samples. In these cases, data can be shared without a separate data/sample request. This may occur, for example, for scientific or logistical reasons during preexpedition planning or during the expedition, if contingency sites are drilled that overlap with a planned expedition. The decision as to whether an expedition is a stand-alone expedition in terms of data/samples or is part of a suite of expeditions is made by the NT-PMT in consultation with the SAC and the Co-Chiefs of the involved expeditions.

As a specific example, if proposed Site NT1-01A is drilled during Expedition 319 but partially or wholly analyzed during Expedition 322, the science parties of Expeditions 319 and 322 will be merged in order to best address the common theme of characterizing subduction inputs. In this scenario, scientists participating in either expedition will have full access to all samples and data from both expeditions, and sample requests will be reviewed and evaluated jointly by the two expedition SACs. This is somewhat different than most previous ODP/IODP expeditions, but will follow the precedent and procedures defined during NanTroSEIZE Stage 1 drilling (e.g., Ashi et al., 2008; Kimura et al., 2008).

Sample and data requests (research proposals)

All shipboard scientists must submit at least one data or sample request in advance of the drilling expedition. Additional requests also may be submitted during or after the expedition if appropriate. The initial sample requests provide the basis for the SAC and Specialty Coordinators to develop an integrated sampling program of both shipboard and postcruise sample requests. The initial sampling 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 the sampling 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, sample requests are due by the end of March 2009.

The IODP Sample, Data, and Obligations Policy (**www.iodp.org/program-policies**) outlines the policy for distributing IODP samples and data and defines the obligations incurred by both ship board and shore-based scientists. Both groups of scientists should also use the Sample/Data Request form (**smcs.iodp.org**) in submitting their requests.

Additional sampling guidelines

The SAC is composed of Co-Chief Scientists, Expedition Project Managers (EPM), the shipboard curatorial representative, and the IODP curator on shore; the SAC for the expedition(s) must approve access to data and core samples requested during the expedition and during the 1 y moratorium, which starts at the end of the drilling expedition. In the event that proposed Site NT1-01A is drilled during Expedition 319, the shared moratorium will then begin from the end of Expedition 322.

All sample frequencies and sizes must be justified on a scientific basis and will depend on core recovery, the full spectrum of other sample/data requests, the expedition objectives, and project-wide NanTroSEIZE objectives.

When critical or volumetrically limited intervals are recovered, there may be considerable demand for samples because of the limited amount of cored material. These intervals (e.g., highly deformed fault zone) may require special handling, a higher sampling density, reduced sample size, or continuous core sampling for a set of particular high-priority research objectives. The SAC may require an additional formal sampling plan before critical intervals are sampled.

All sampling to acquire ephemeral data types or to achieve essential sample preservation will be conducted during the expedition.

Sampling for individual scientists' postcruise research may be conducted during the expedition, or may be deferred to postcruise.

Contingency plans

Contingency operations for Expedition 319 riserless drilling is based on the current state of knowledge at the time of writing this *Scientific Prospectus* and may be modified both before and during Expedition 319 based on continuing NT-PMT discussions.

Site C0002

Riserless drilling at Site C0002 is the primary contingency plan for Expedition 319 (Fig. **F15**). The scientific and operational objectives at Site C0002, which was previously drilled during Expeditions 314 (LWD) and 315 (coring), are to drill with LWD to 1000 mbsf and install 9⅝ inch casing using a similar configuration to that planned at proposed Site NT2-01J. The location for casing screens at this site will be selected on the basis of previous data from Expeditions 314 and 315 and from LWD data collected on this expedition. The casing will be cemented and a bridge plug with a pore pressure and temperature instrument package like that planned for proposed Site

NT2-01J will be emplaced to monitor formation conditions at the screened interval. This will achieve the goal of drilling and preparing for a riserless observatory in the seaward portion of the Kumano Basin as part of a spatially distributed observatory network for NanTroSEIZE, should operational scheduling permit drilling at this alternate site. These operations at Site C0002 will also serve as contingency should operations prove not possible at proposed Sites NT2-01J or NT2-01K.

Proposed Site NT1-01A

Should operations at the riser and/or riserless observatory sites become impossible, or if time permits additional drilling operations during Expedition 319, proposed Site NT1-01A is an additional contingency site (Fig. **F16**). This site is located in the Shikoku Basin seaward of the trench above a basement high and provides a paired site for proposed Site NT1-07A, which constitutes the primary target for Expedition 322 from August 2009 to September 2009. The primary scientific objectives at this site are to characterize the material and state of the sediments atop the incoming (subducting) oceanic plate, with specific emphasis on the subducted strata. This will be achieved by analysis of core and through shore-based geotechnical studies of recovered core material. As noted above, if this contingency plan is invoked, the shipboard science parties for Expeditions 319 and 322 will be merged, the sample and data requests will be evaluated by a joint SAC, and a common moratorium period may be assigned.

Personnel changes and onshore briefing logistics

Because Expedition 319 extends over a four month period and involves an initial phase dedicated to preparations related to riser drilling, the expedition will be staffed in three, partially overlapping phases (Fig. **F17**). The initial phase (5 May to 4 June 2009) will involve only the Chief Project Scientists and an EPM. At the end of this initial phase (4 June) the Chief Project Scientists are replaced by two Co-Chief Scientists (Byrne and Araki) and joined by eleven members of the science party who remain on the ship for ~45 days. In the final staffing phase, one of the Co-Chiefs and all of the science party are replaced (over a three-day period, 17–20 July) by a third Co-Chief (Saffer) and a second group of eleven scientists. To ensure continuity as the science parties rotate in the middle of the expedition, Co-Chief rotations are planned to be out of phase with the rotations of the science parties and a fourth Co-Chief (McNeill) will be on the ship during the transition in science parties. As a result, one Co-Chief

(Araki) will return to the ship for the last 22 days of the expedition. Finally, short debriefing periods with selected Specialty Coordinators are planned between the staffing phases (~ 3–5 June and 16–21 July) and at the end of the expedition (31 August). This will help keep the Specialty Coordinators informed of progress and problems encountered during the expedition, and allow them to help guide the science party and Co-Chiefs through any decisions that must be made because of any special situations that may arise.

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Table T1. Operations and time estimates for Expedition 319. (**See table notes.**)

Proposed Site	PTD (mbsf)	Water depth (m)	Total (mbsl)	Operation	Estimated days	Number of cores
NT2-11B						
	1600	2060	3660	Move to site, preparation for drilling (BHA, etc.)	7	
				Run and jet-in 36 inch conductor to 60 mbsf	3	
				Drill 26 inch hole to 700 m - Run and cement 20 inch casing	8.5	
				Run BOP w/riser fairing, land and test BOP	11	
				Make up and run 17 inch DOC assembly - Displace hole w/mud - XLOT - Drill 12-1/4 inch hole to 1510 mbsf - Cut RCB core (90 m) to 1600 mbsf - Wiper trip - Wireline Log 1 - Open hole to 17 inches for 13-3/8 inch casing - Wiper trip - Run and cement 13-3/8 inch casing	21.5	?
				Run 13-3/8 inch casing scraper	1	
				Run USI-CBL-VDL-GR	1	
				Run VSI, zero offset and walkway	2	
				(contingency – dummy casing hanger/temp recorder)	(2)	
				Retrieve BOP, riser, and fairing	7	
				Set corrosion cap, retrieve transponders	2	
				Contingency days	19	
				Total days	83	
NT2-01J						
	525	2535	3060	Move to site, prepare for drilling (BHA, etc.)	2	
				Prepare and rig up 20 inch casing	4.5	
				Run and jet-in 20 inch conductor to 36 mbsf	2.5	
				Make up and run 12-1/4 inch LWD assembly - Drill LWD to 525 mbsf - Wiper trip - Set 9-5/8 inch casing - Dummy sensor run - Wireline logging	10.5	
				Set retrievable bridge plug w/sensors	2.5	
				Set suspension cap, retrieve transponders		
				Contingency days	7	
				Move to Shingu	1	
				Total days	31	

Notes: PTD = proposed total depth. mbsf = meters below seafloor. BHA = bottom-hole assembly. DOC = depth-of-cut. XLOT = extended leak-off test. RCB = rotary core barrel. USI = ultrasonic imager, CBL = cement bond log, VDL = variable density logger, GR = gamma ray. LWD = logging-while-drilling.

Figure F1. A. Map of study area showing drill sites. Black box = location of the 2006 three-dimensional seismic survey, black line = KR0108-5 two-dimensional seismic survey, yellow arrows = computed far-field convergence vectors between Philippine Sea plate and Japan (Seno, 1993; Heki, 2007), stars = epicentral location of great earthquakes. Inset shows location of Nankai Trough around the drill sites. (**Continued on next page.**)

A

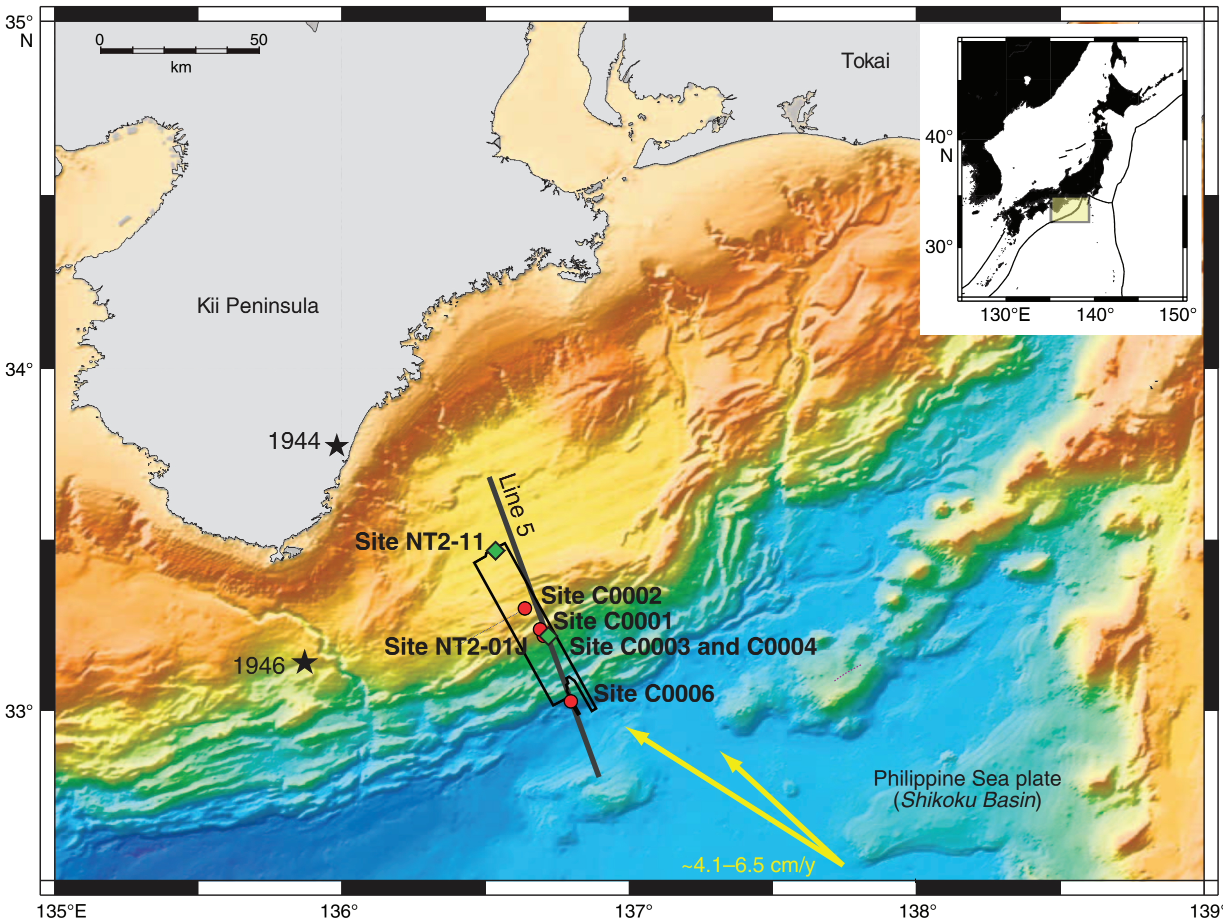


Figure F1 (continued). B. Map of drill sites and coseismic very low frequency earthquakes. Contours = slip during the 1944 event (0.5 m intervals), red box = region of recorded very low frequency earthquakes.

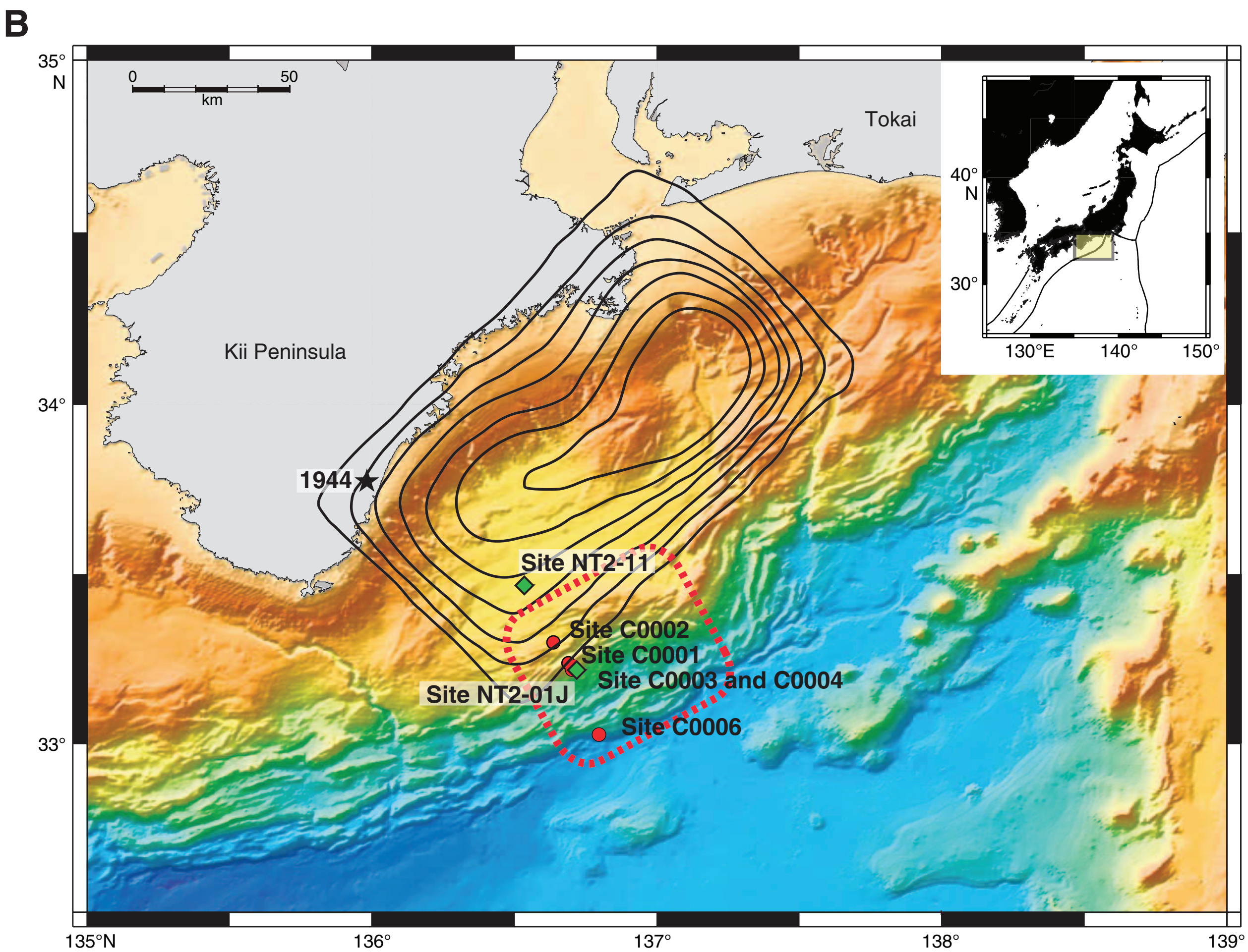


Figure F2. A. Seismic diagram at regional scale showing interpretation by Park et al. (2002) and drill sites. (**Continued on next page.**)

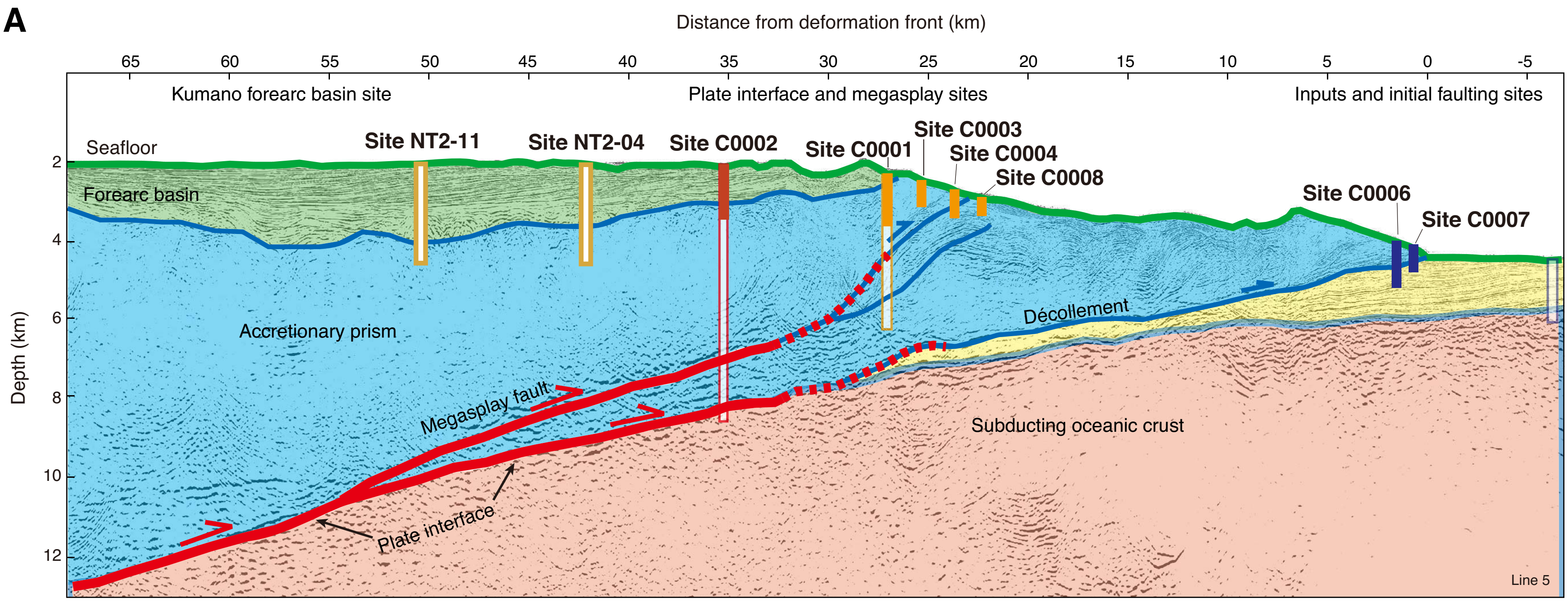


Figure F2 (continued). B. Seismic profile of all drill sites (bottom) and Expedition 319 proposed drill sites (top).

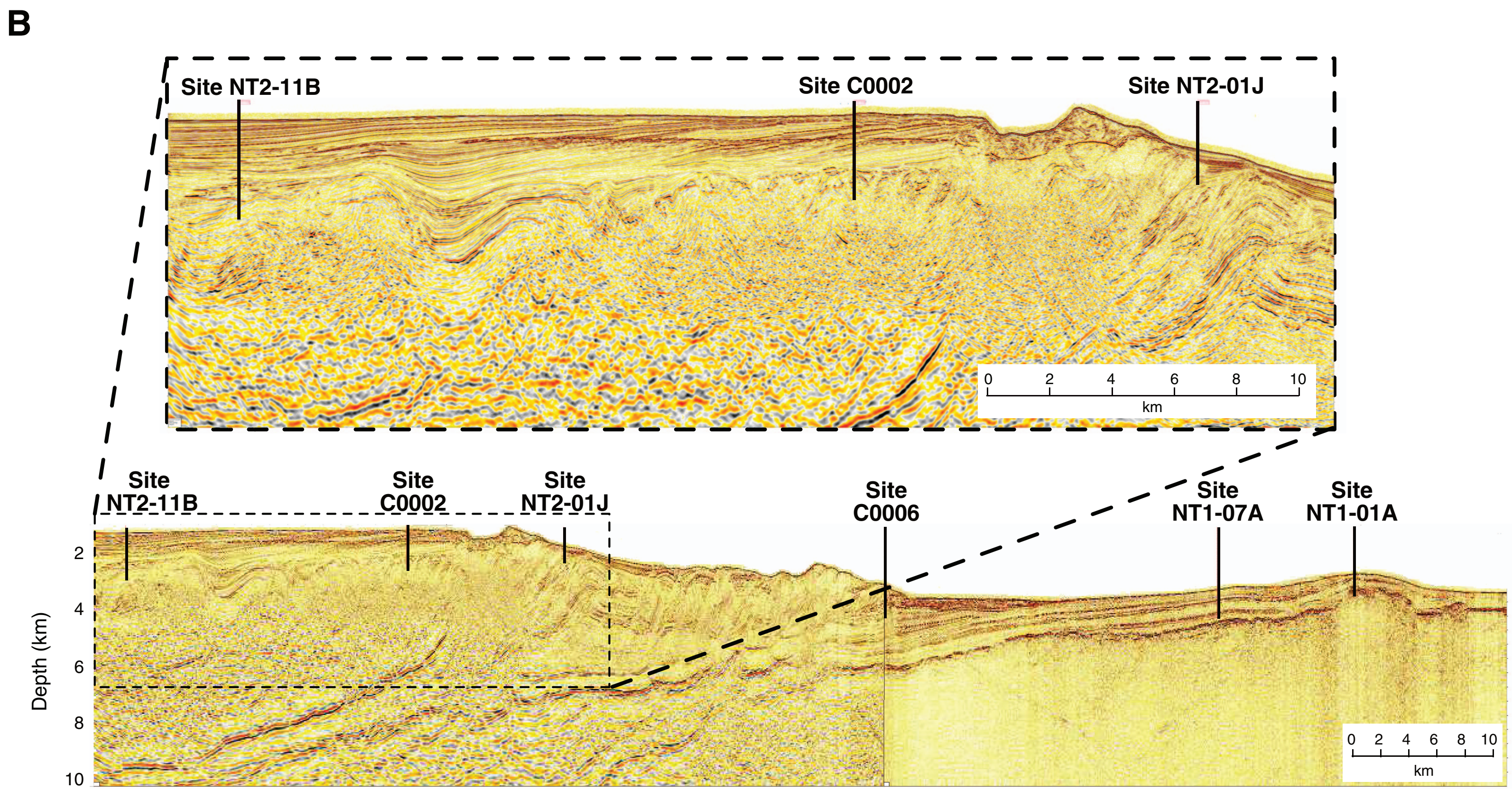


Figure F3. Detailed map of proposed Sites NT2-11A and NT2-11B. In-line (IL) and cross-line (XL) seismic tracks are indicated.

Figure F4. Seismic in-line (IL) and cross-line (XL) profiles of proposed Site NT2-11; primary (NT2-11B) and secondary (NT2-11A) drill sites. VE = vertical exaggeration.

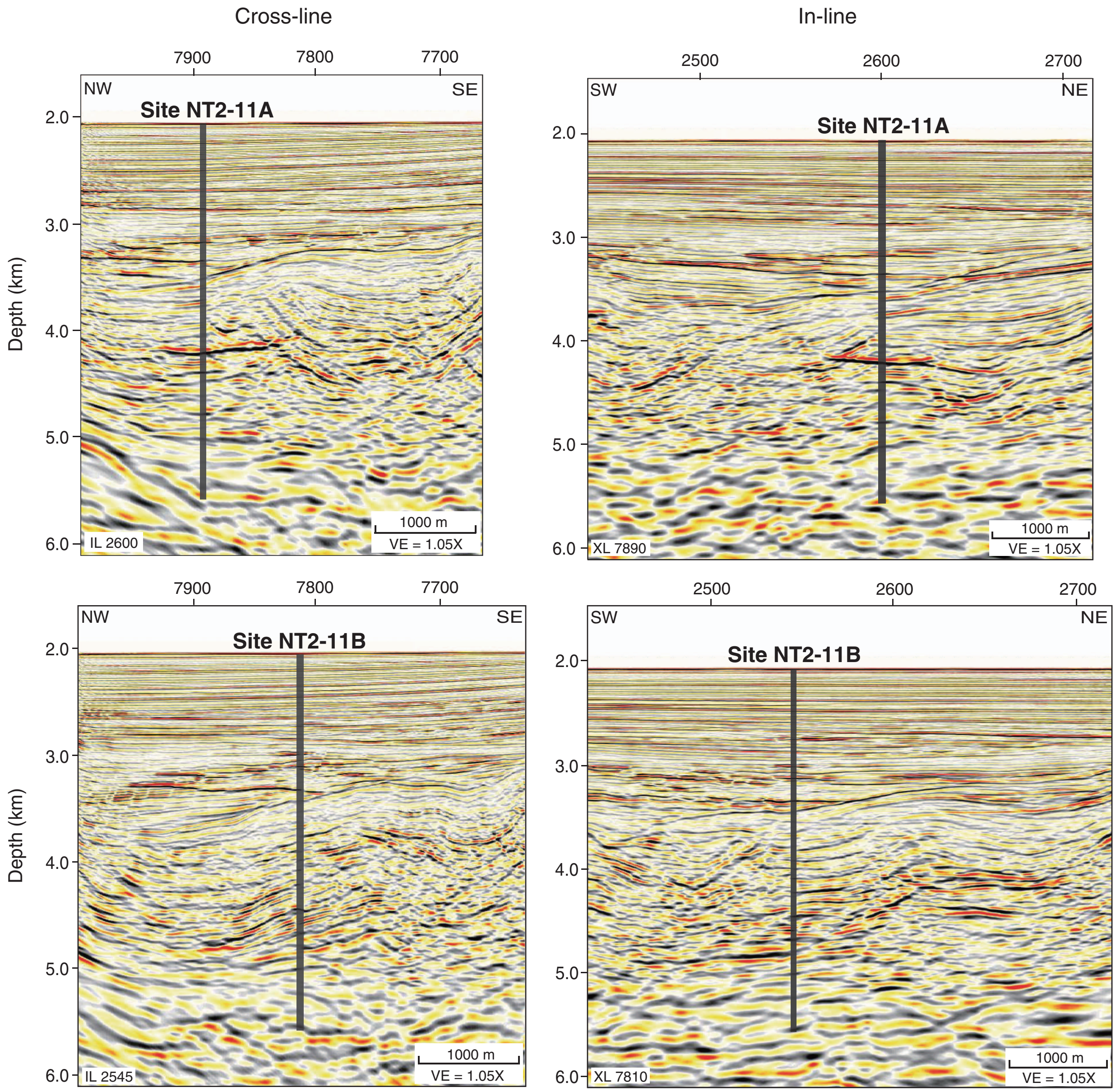


Figure F5. Detailed map of proposed Sites NT2-01K and NT2-01J. In-line (IL) and cross-line (XL) seismic tracks are indicated.

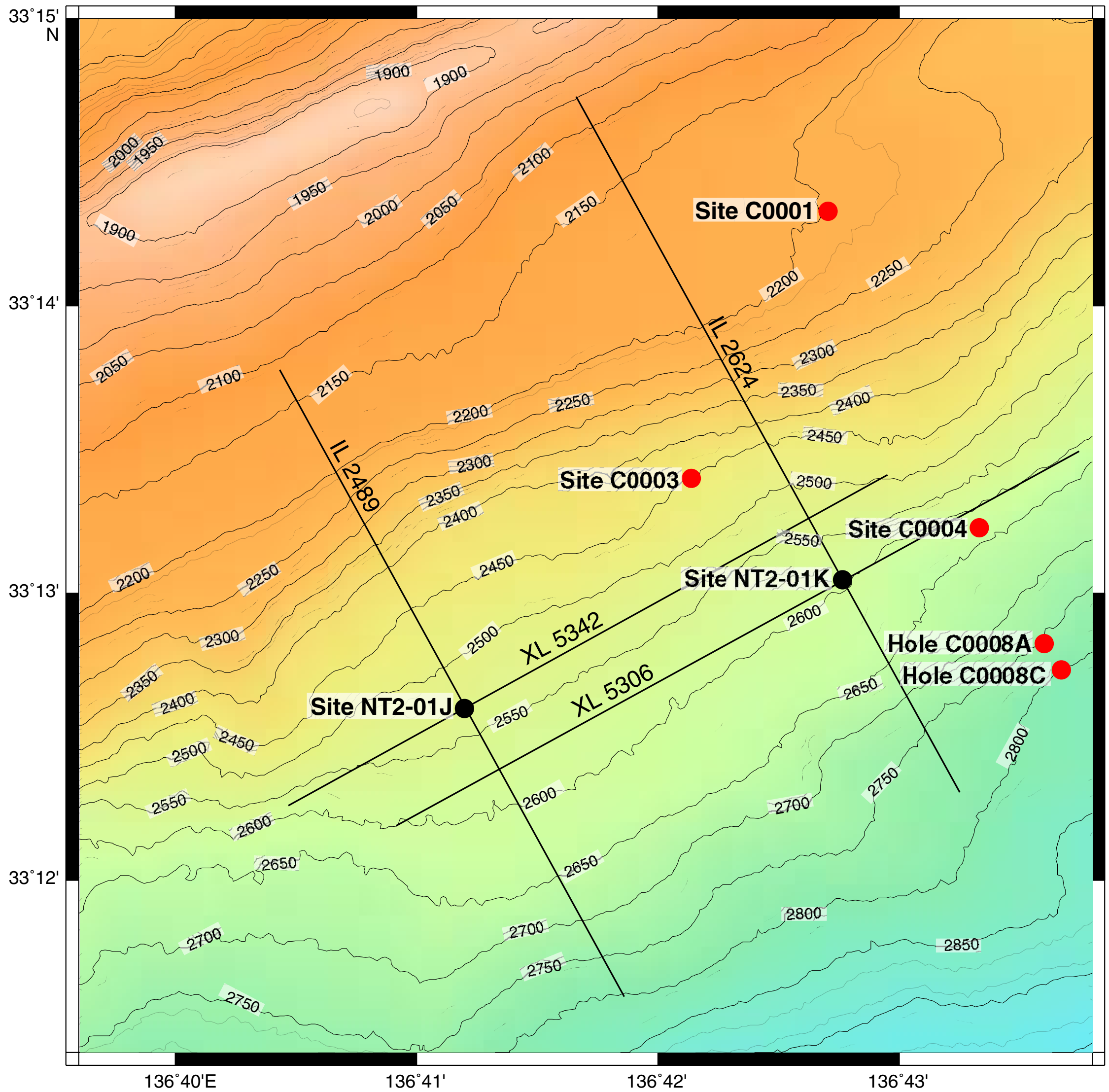


Figure F6. Seismic in-line (IL) and cross-line (XL) profiles of proposed Sites (**A**) NT2-01J (primary) and (**B**) NT2-01K (secondary). VE = vertical exaggeration.

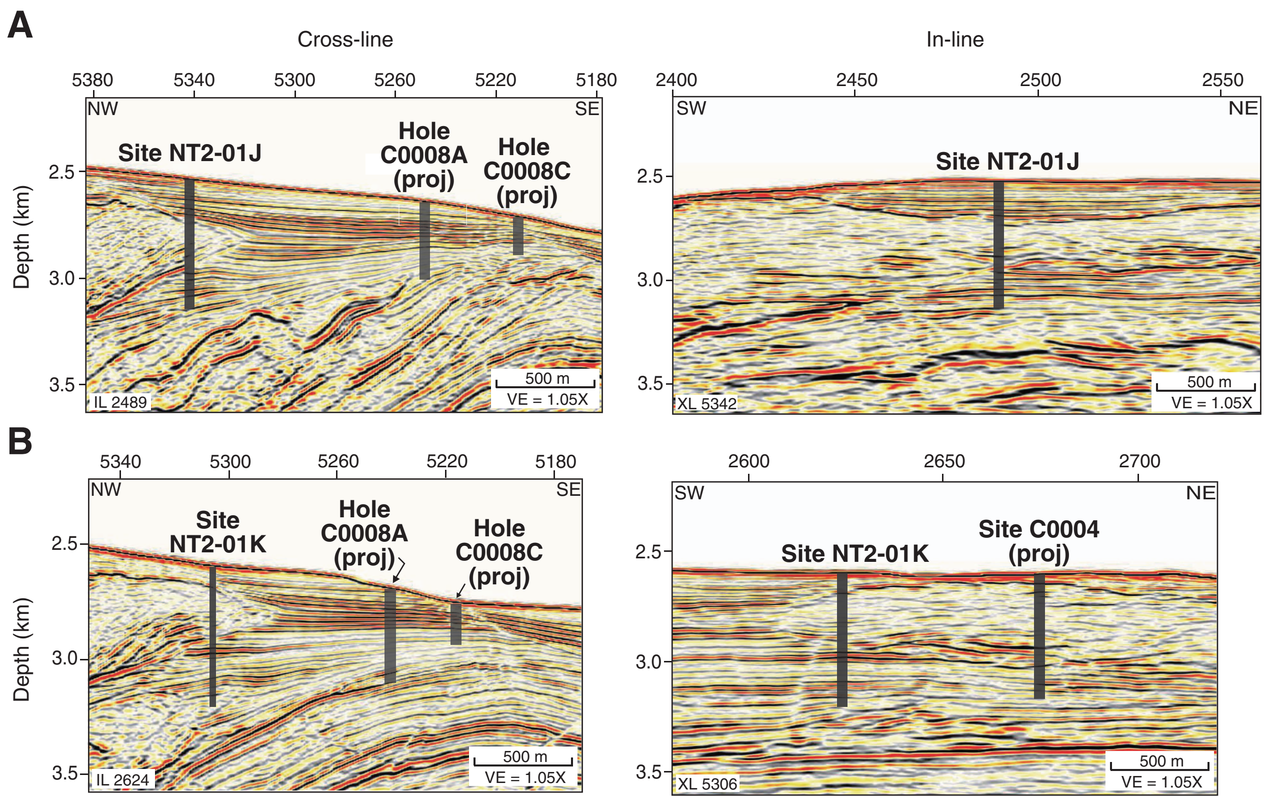


Figure F7. Detailed schematic diagram of the proposed Site NT2-11B borehole, showing casing strings, TD, and operations. BOP = blowout preventer, VSP = vertical seismic profile.

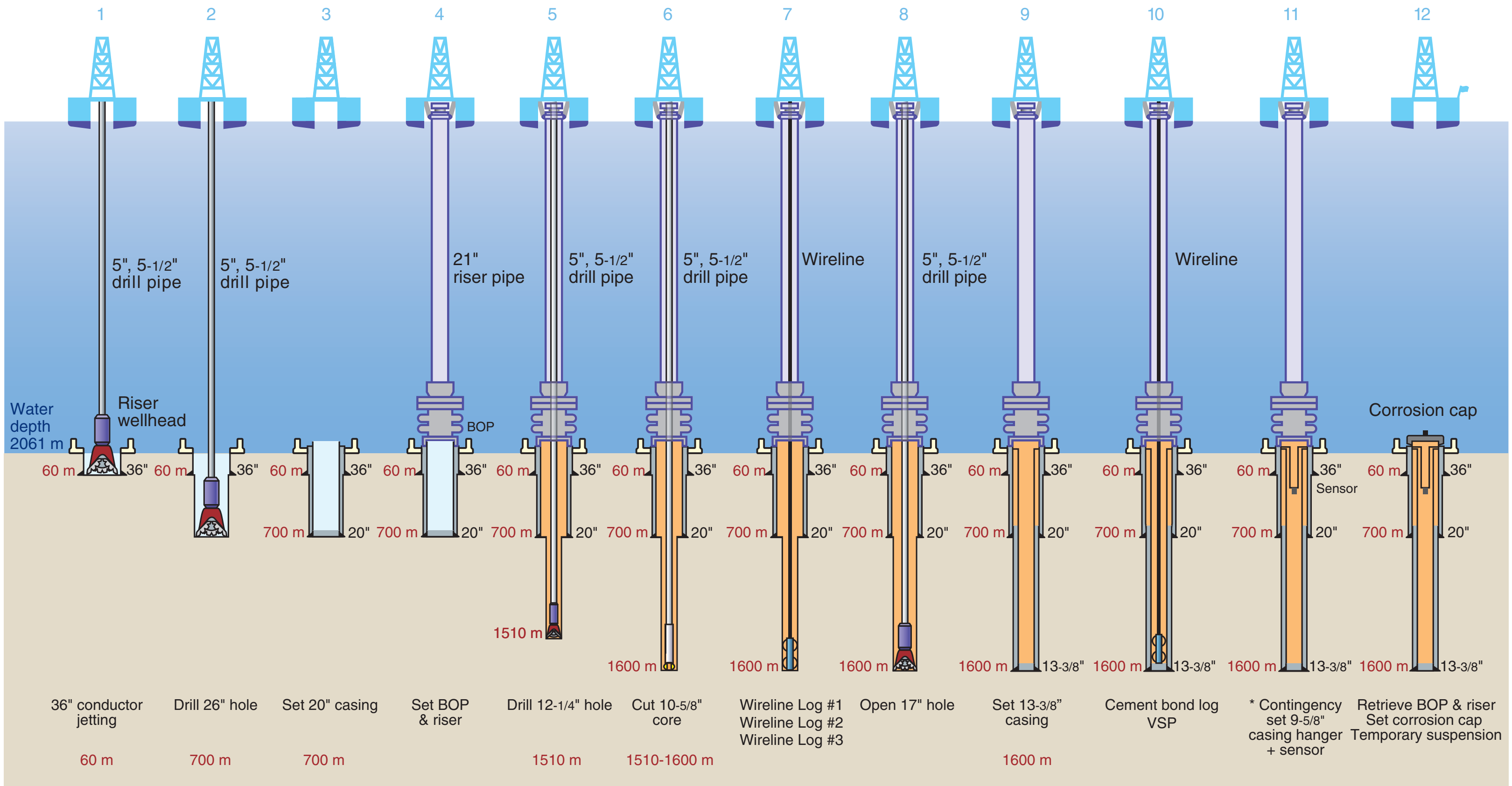


Figure F8. Detailed schematic diagram of the proposed Site NT2-01 borehole, showing casing strings, TD, and operations. LWD = logging while drilling.

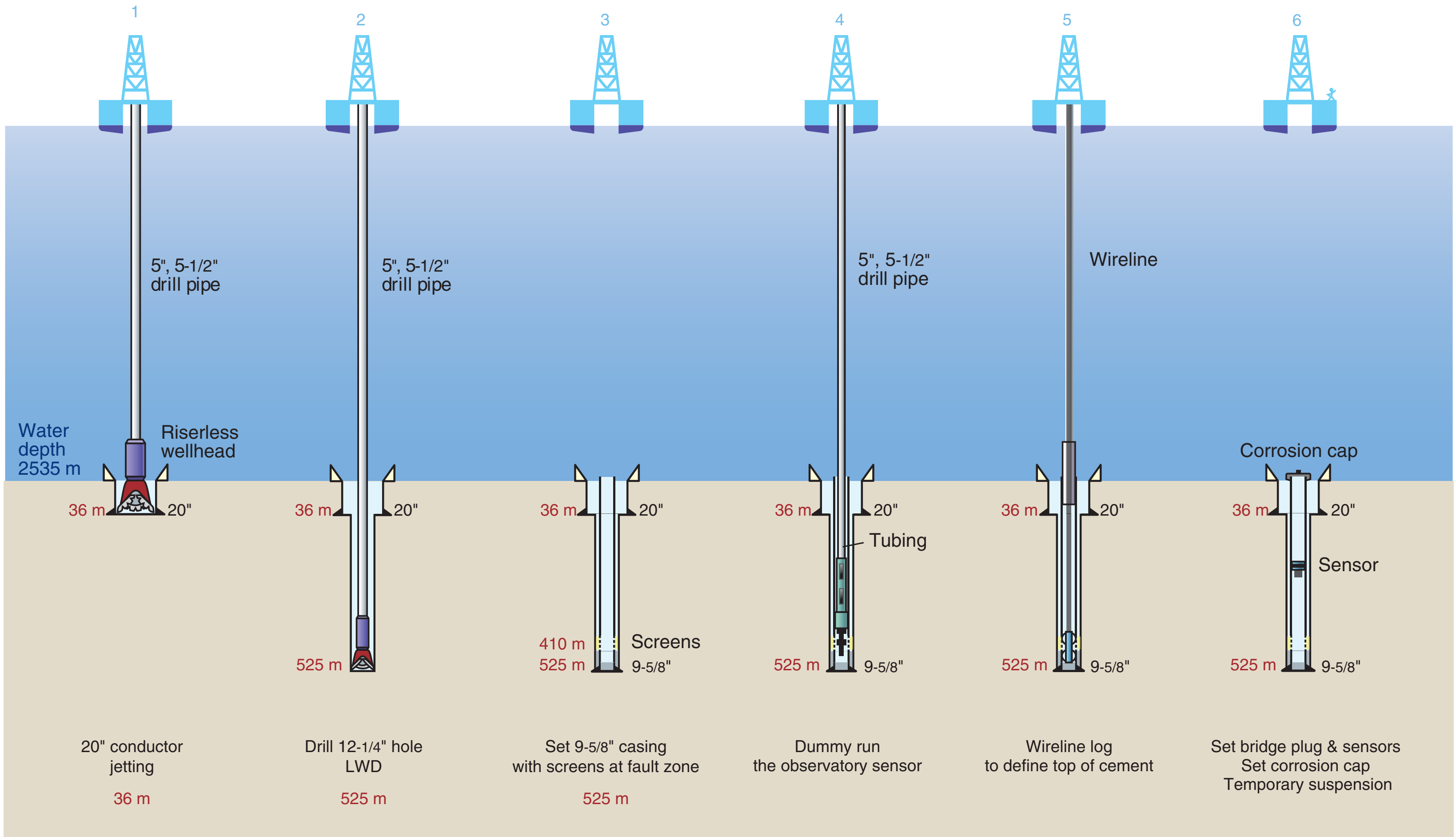


Figure F9. Thermistor string installation (proposed) for proposed Site NT2-11B. MTL = miniature temperature logger.

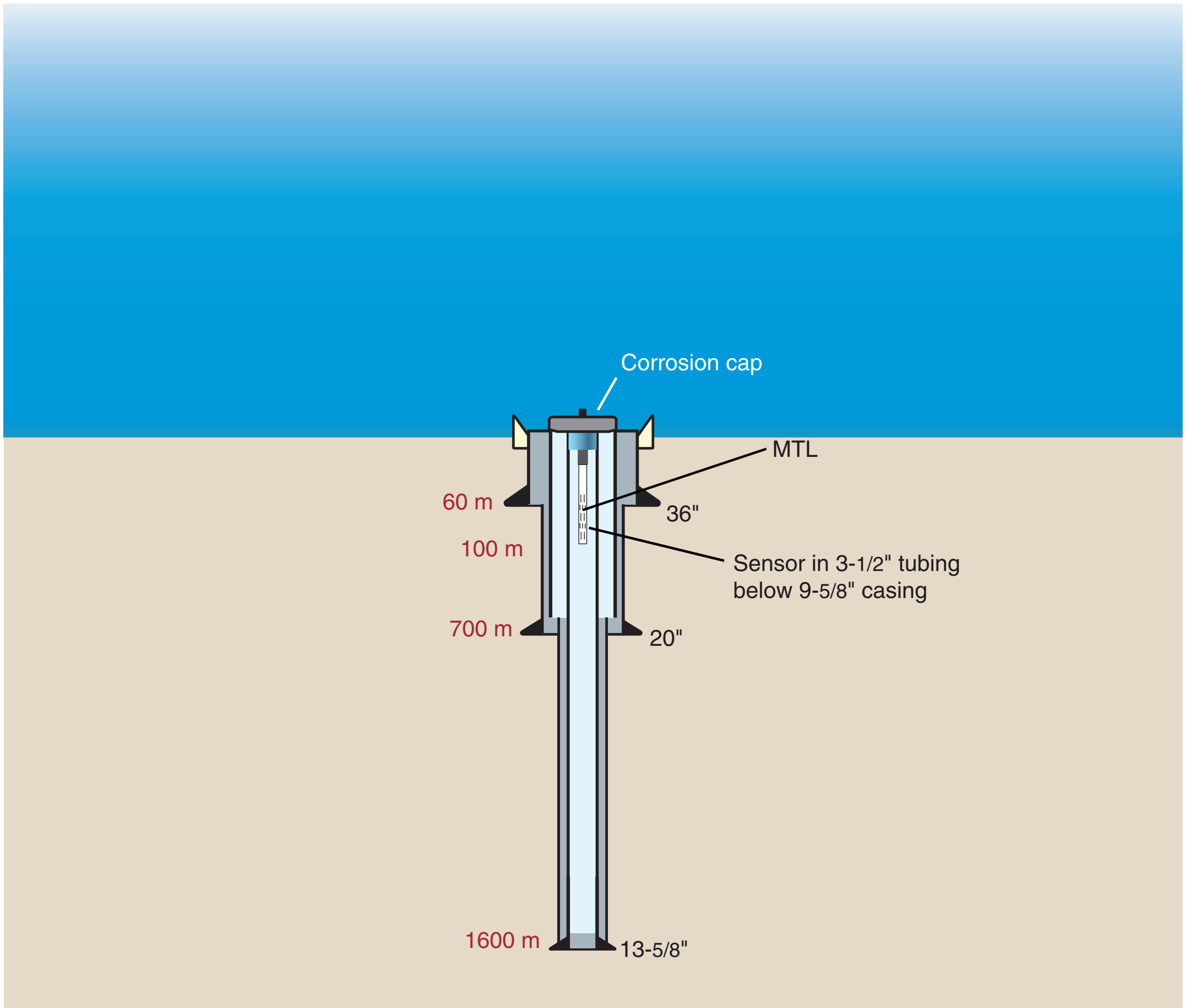


Figure F10. Logging tools planned for use in Expedition 319. **A.** Measurement-while-drilling (MWD)/LWD tools assembly. **B.** Formation MicroImaging (FMI), Sonic Scanner, and Environmental Measurement Sonde (EMS) tool string. **C.** Platform Express and EMS tool string. **D.** Modular Formation Dynamics Tester (MDT) dual packer tool string. ARC = Array Resistivity Compensated, APWD = annular pressure while drilling.

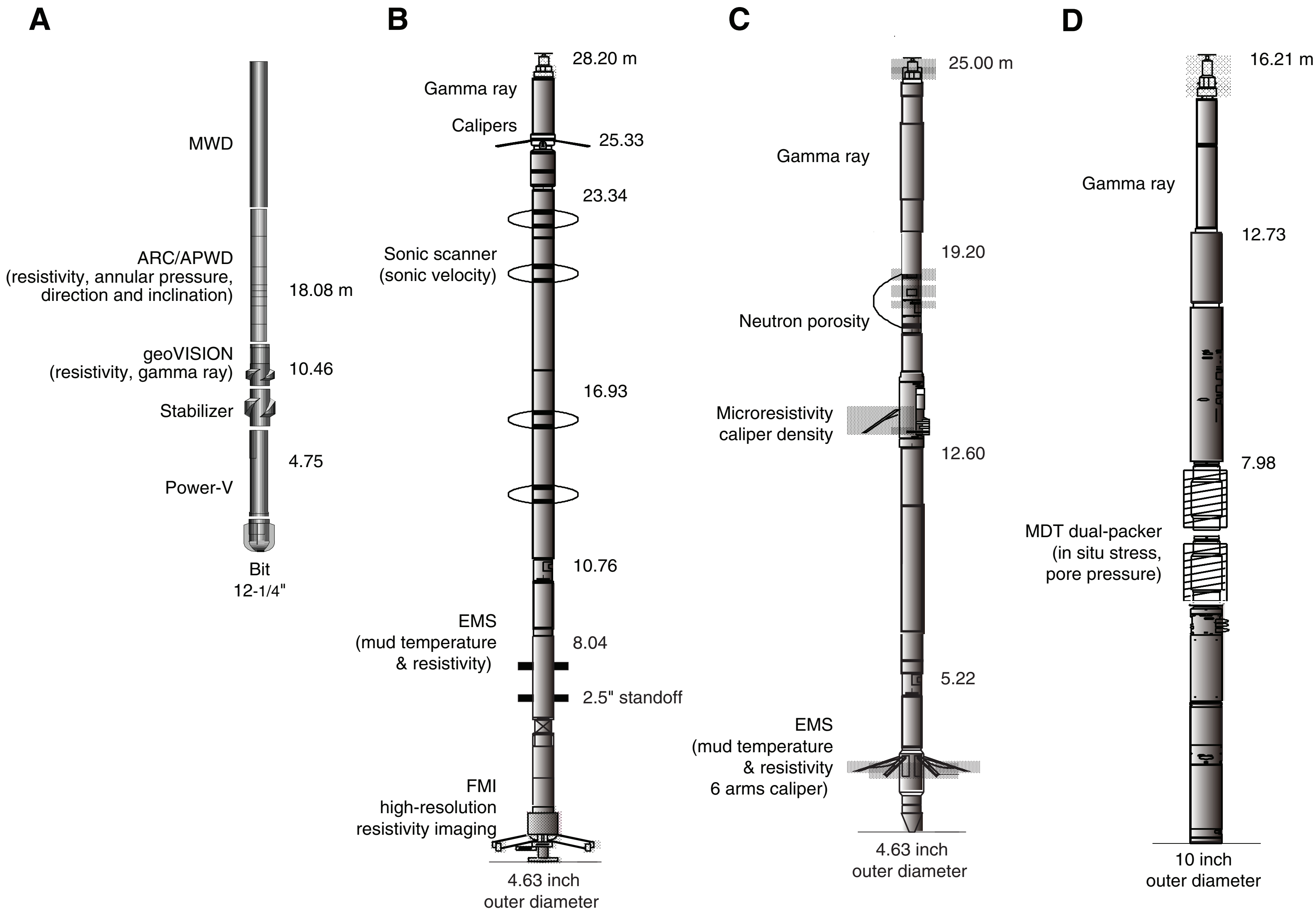


Figure F11. VSP tool string. VSI = Versatile Seismic Imager.

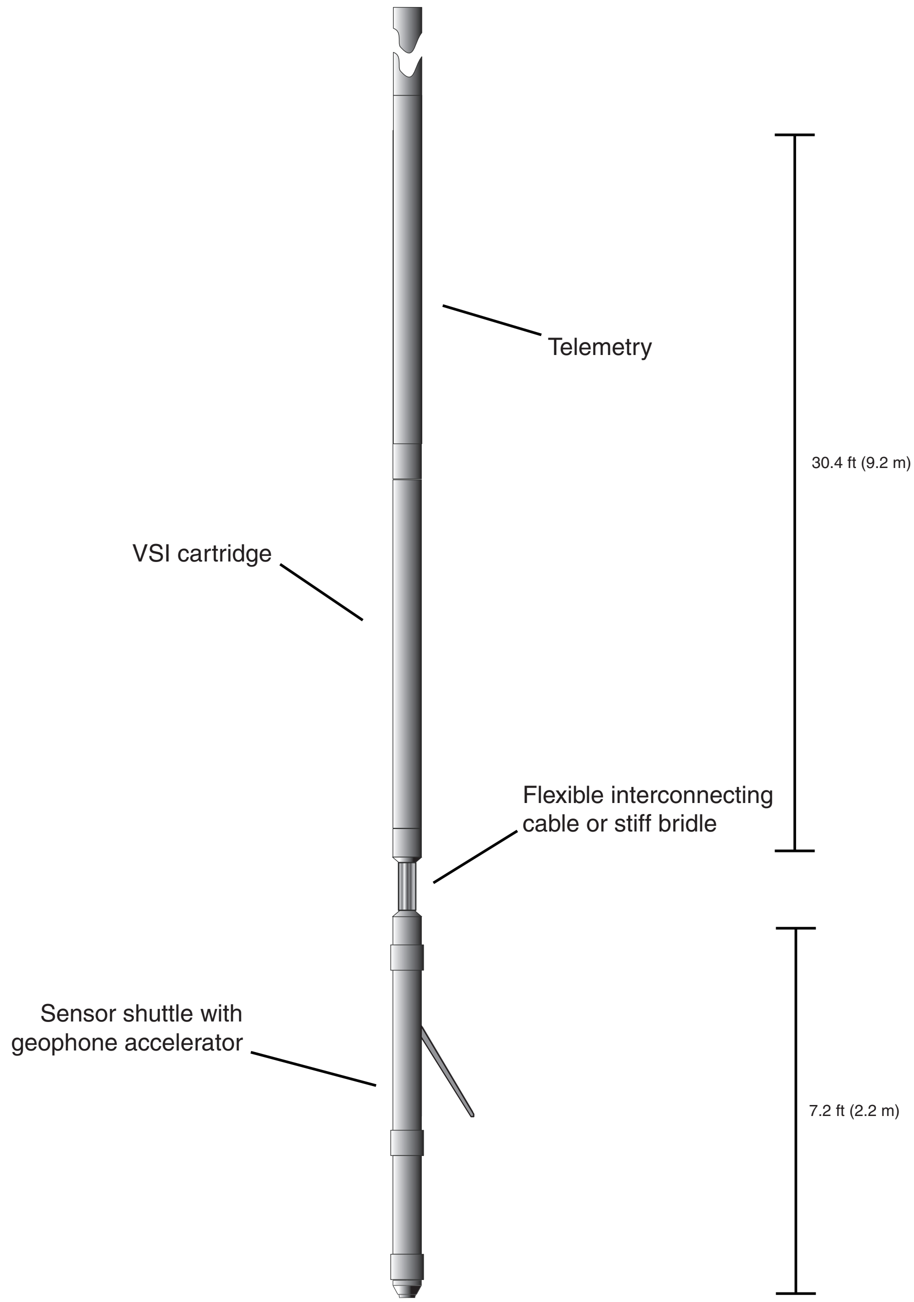


Figure F12. Schematic diagram of the dummy run test string for proposed Site NT2-11.

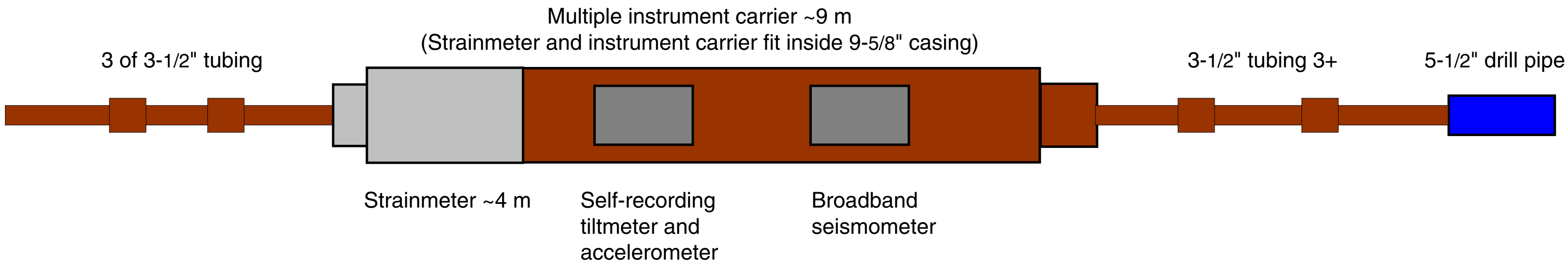


Figure F13. Schematic design of the instrumented carrier (SmartPlug–Instrumented bridge plug) to be hung from the retrievable bridge plug in proposed Site NT2-01J. **A.** Side view. **B.** Cross-sectional top view. PPC = pressure period counter/logger, DD = lithium thionyl chloride batteries (4 y capacity at 1 min sampling rate), 8B 7000-2 = paroscientific pressure transducer, MTL = Antares miniature temperature logger. Pressure case = 6 inch diameter, 8 inch OD, flange-mounted end-caps with high-pressure port feed through bulkheads leading to pressure sensors. Top end-cap fabricated with 3.5 inch OD EU 8Rd thread for mounting to Baker-Hughes retrievable casing packer.) All units are in inches.

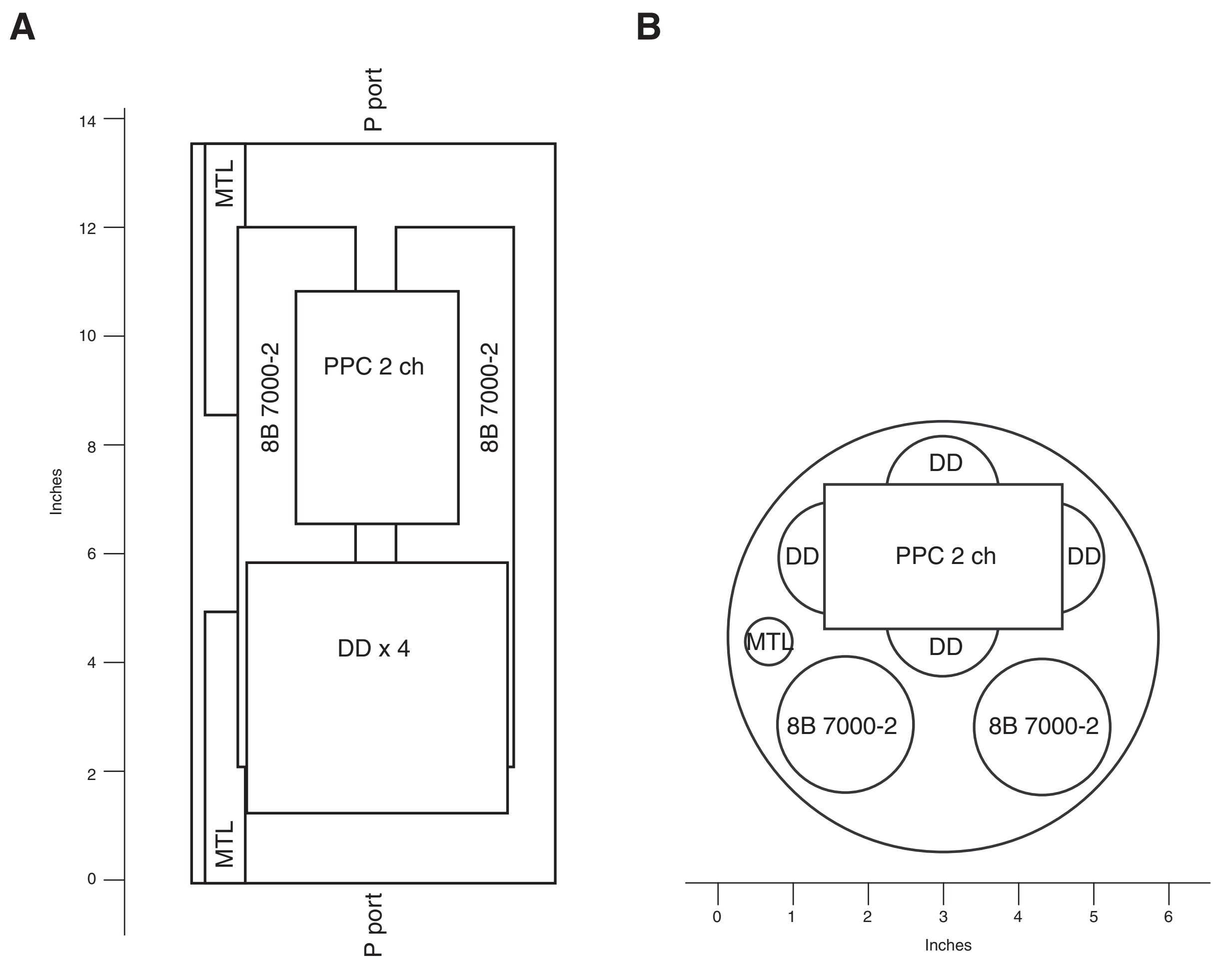


Figure F14. A. Personnel distribution and flow charts for the sampling and analysis of cuttings. Movement and splitting of samples from the shale shaker to the mud logging unit and science laboratory. Delivery of data reports to Operation Superintendent (OSI), Co-Chiefs, and Expedition Project Manager (EPM) is also shown. (**Continued on next page.**)

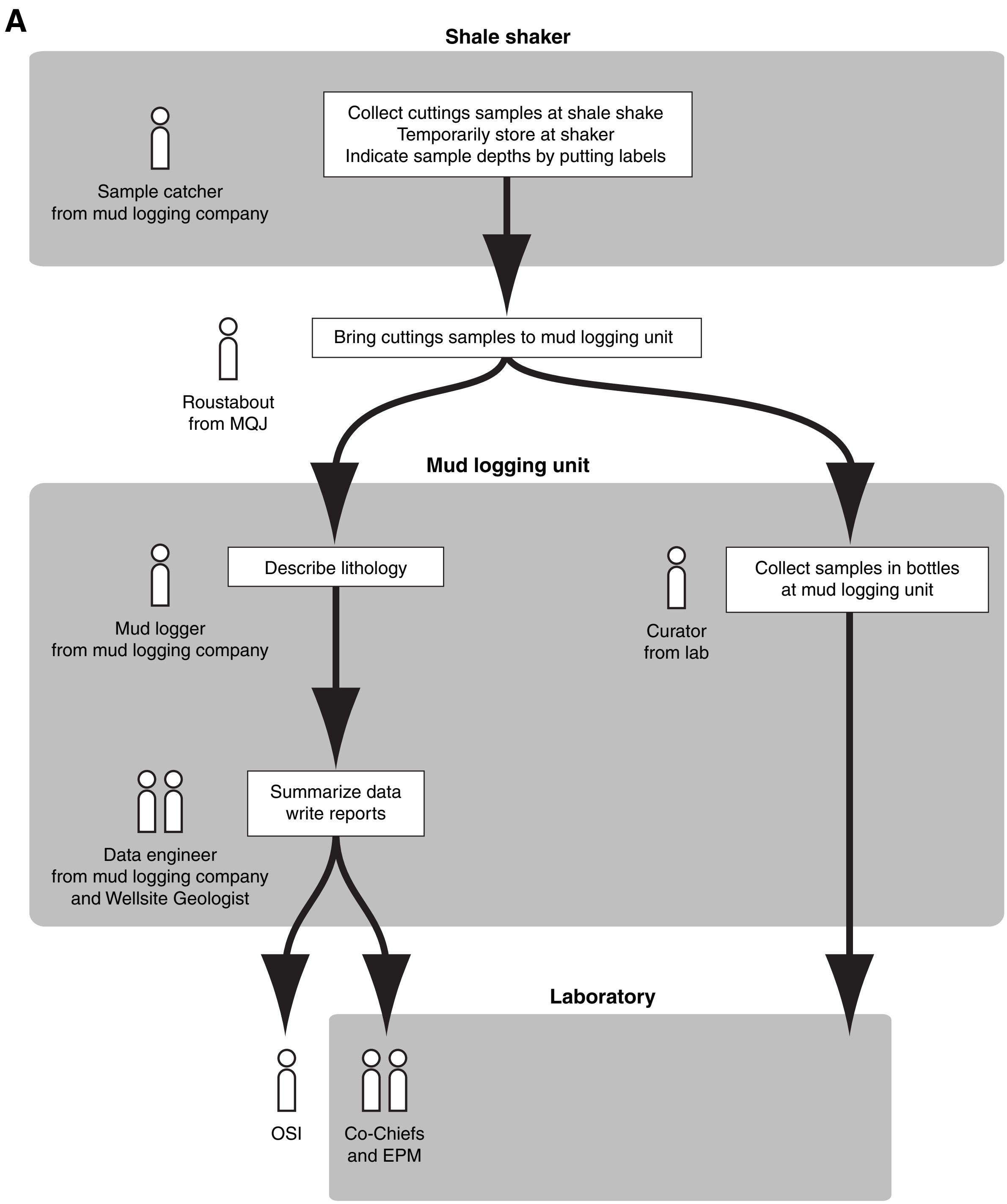


Figure F14 (continued). B. Cuttings analysis flow and personnel allocation within the laboratory. Each figure icon = one personnel assignment for 24 h (i.e., two individuals), half icon = one for 12 h. Shaded areas = activity groups and personnel assignments. * = two paleontologists and no observatory scientist for Party A and one paleontologist and one observatory scientist for Party B. Diamonds = some cuttings sample residues are trashed after personal samplings, double framed boxes = "soft" cuttings only limited measurements performed.

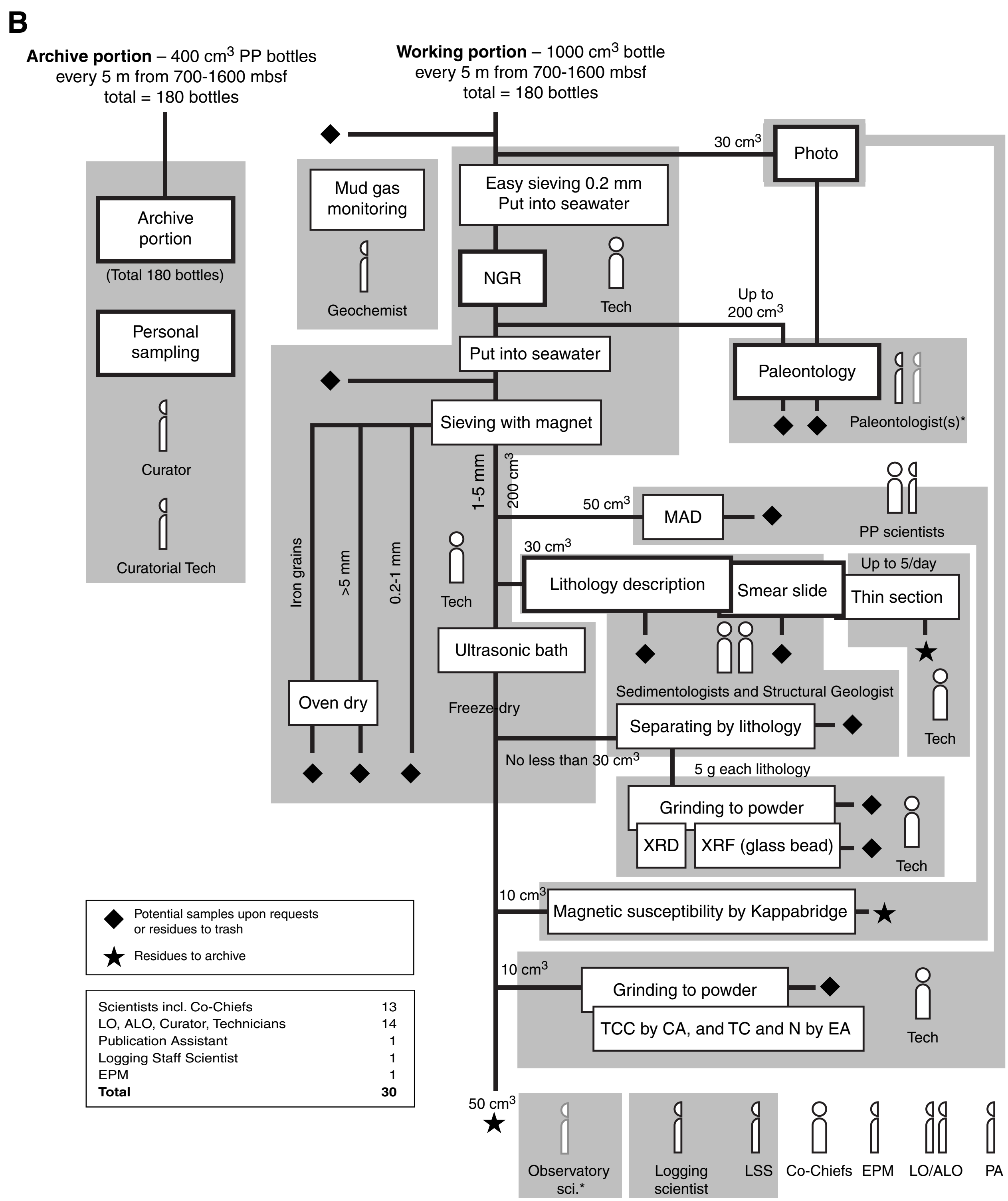


Figure F15. Detailed 3-D seismic profile of Site C0002. **A.** Cross-line (XL). **B.** In-line (IL). Taken from Moore et al. (2009) figs. F21A, F22A. VE = vertical exaggeration.

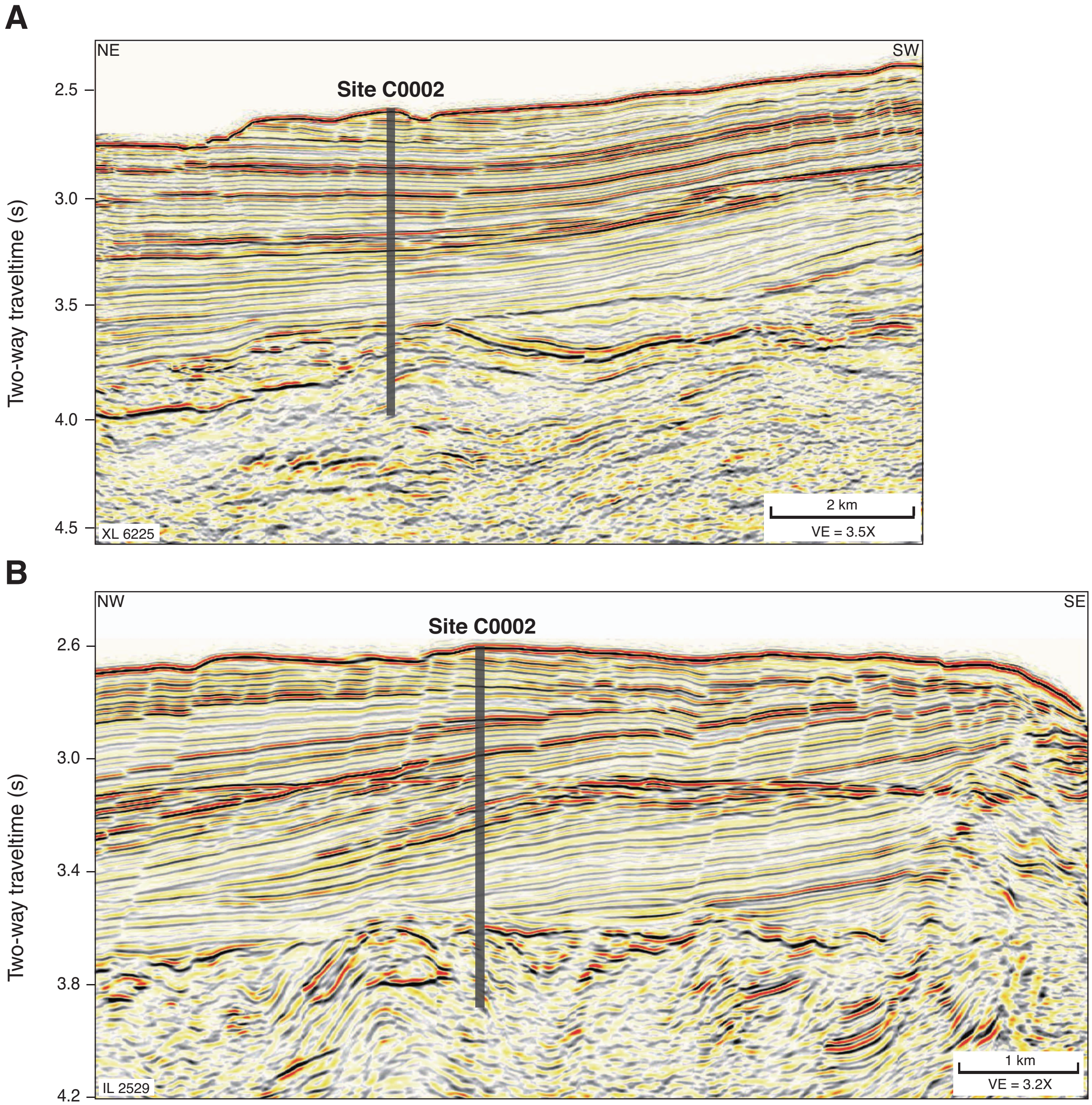


Figure F16. Detailed 3-D seismic profile for proposed Site NT1-01A. **A.** In-line (IL) survey. **B.** Cross-line (XL) survey. VE = vertical exaggeration.

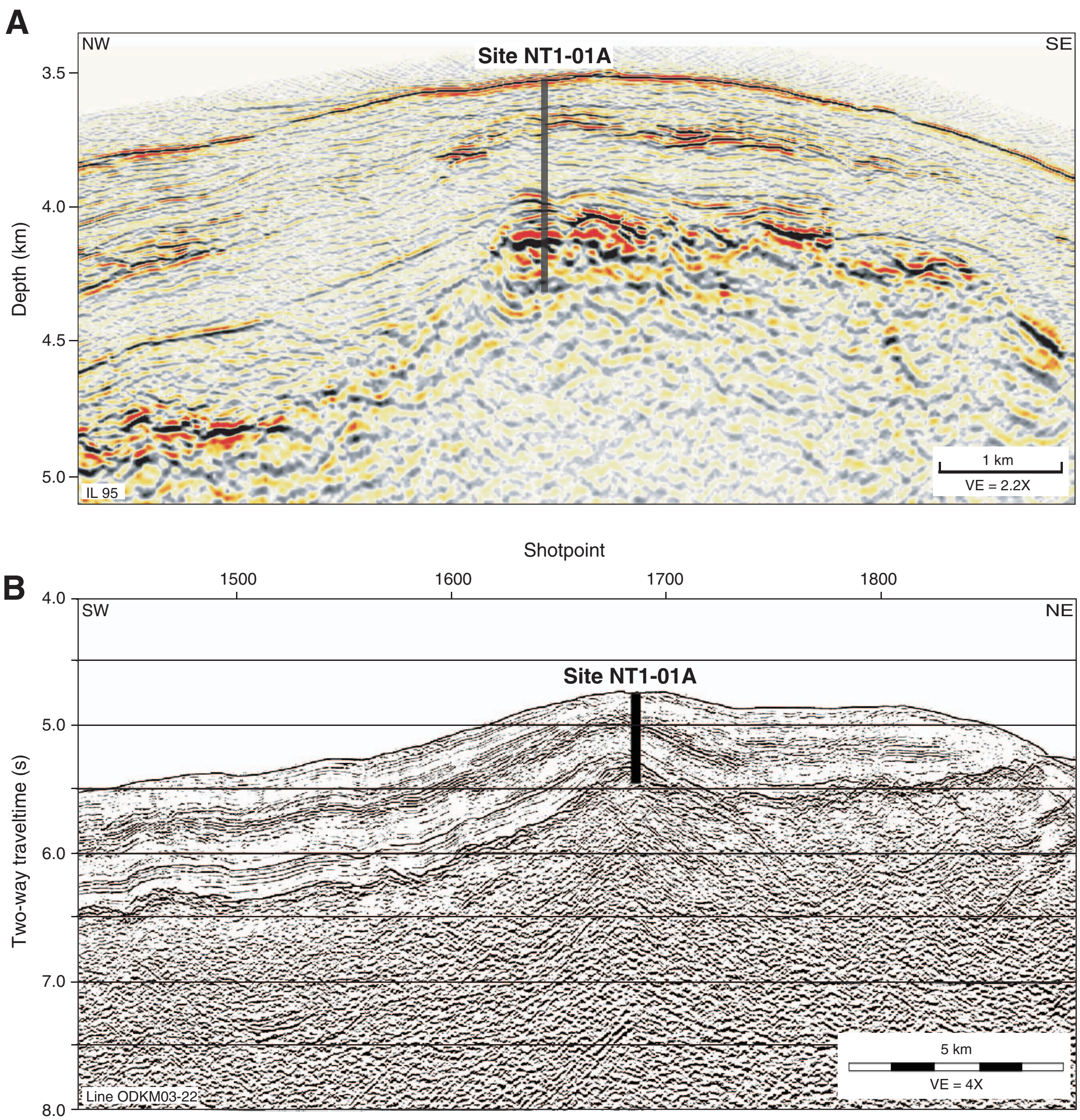
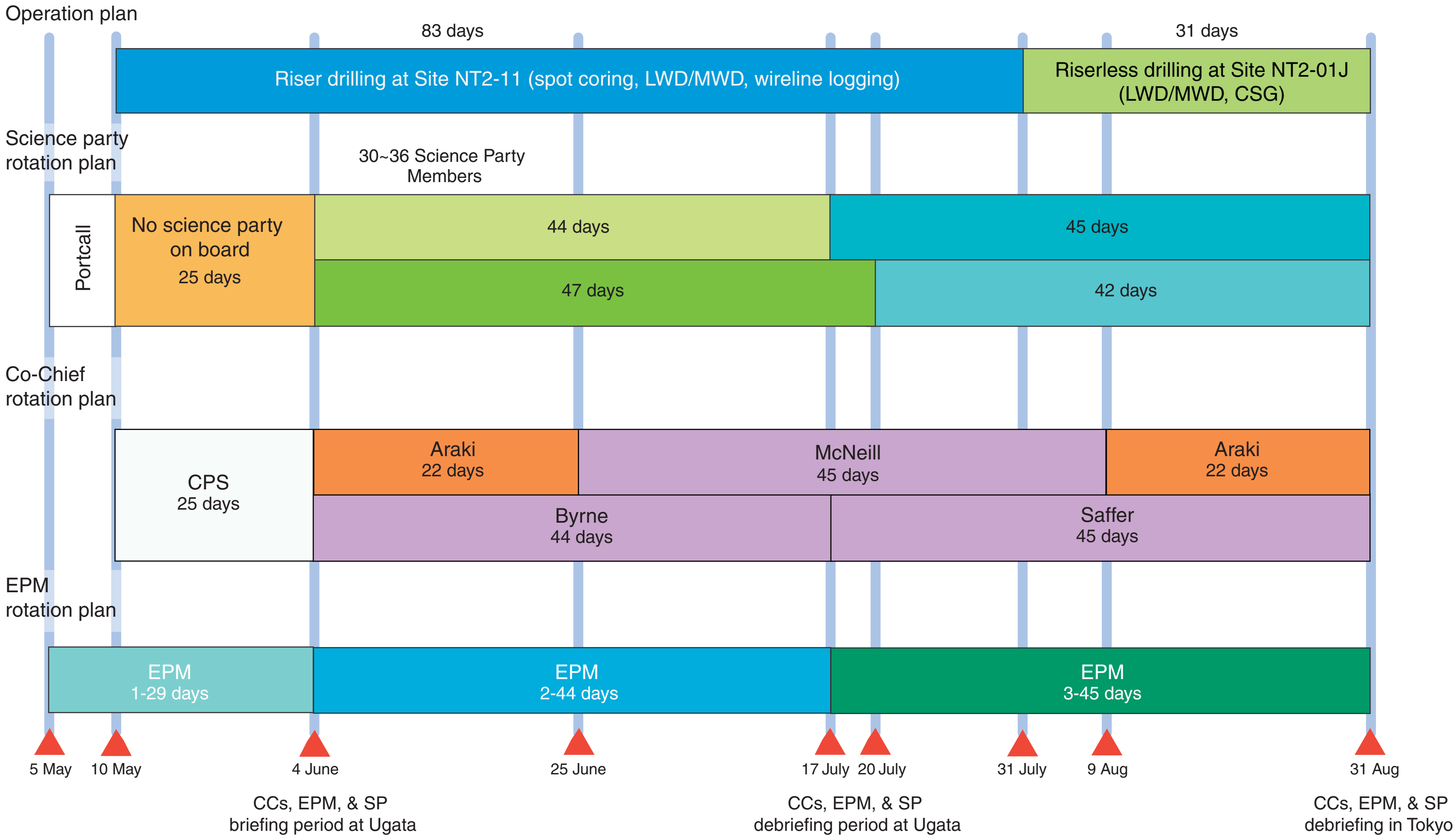


Figure F17. Expedition 319 Co-Chiefs (CC), Science Party (SP), and Expedition Project Manager (EPM) crossover briefing and transfer schedule. LWD = logging while drilling, MWD = measurement while drilling, CSG = casing, CPS = Chief Project Scientists.



Site summaries

Proposed Site NT2-11B

Priority:	Primary: *Chikyu* Expedition 319 (riser)
Position:	33°27.471′N, 136°32.150′E
Water depth (m):	2061
Target drilling depth (mbsf):	1600
Approved maximum penetration (mbsf):	1600
Survey coverage:	Extensive data from 3-D seismic data: • In-line 2545 • Cross-line 7810
Objectives:	• Drill and case long-term observatory hole • Take cuttings and core samples to define lithology, physical properties, and composition • Constrain in situ stress and pore pressure
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319: • Pilot hole jet-in (60 mbsf) • Wireline • RCB spot coring • LWD/MWD • Wireline • Cuttings analysis
Anticipated lithology:	Hemipelagic mud, mudstone, and siltstone/sandstone

Site summaries (continued)

Proposed Site NT2-11A

Priority:	Alternate for proposed Site NT2-11B: *Chikyu* Expedition 319 (riser)
Position:	33°28.212′N, 136°32.419′E
Water depth (m):	2060
Target drilling depth (mbsf):	1600
Approved maximum penetration (mbsf):	1600
Survey coverage:	Extensive data from 3-D seismic data: • In-line 2600 • Cross-line 7890
Objectives:	• Drill and case long-term observatory hole • Take cuttings and core samples to define lithology, physical properties, and composition • Constrain in situ stress and pore pressure
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319: • Pilot hole jet-in (60 mbsf) • Wireline • RCB spot coring • LWD/MWD • Wireline • Cuttings analysis
Anticipated lithology:	Hemipelagic mud, mudstone, and siltstone/sandstone

Site summaries (continued)

Proposed Site NT2-01J

Priority:	Primary: *Chikyu* Expedition 319 (riserless)
Position:	33°12.597′N, 136°41.188′E
Water depth (m):	2535
Target drilling depth (mbsf):	525
Approved maximum penetration (mbsf):	550
Survey coverage:	Extensive survey data from 3-D seismic data: • In-line 2489 • Cross-line 5342
Objective:	Drill and case long-term observatory hole
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319: • Wireline • LWD/MWD • Place sensors on bridge plug for later retrieval
Anticipated lithology:	Hemipelagic mud with turbidite sand, sedimentary breccia, and hemipelagic mudstone.

Site summaries (continued)

Proposed Site NT2-01K

Priority:	Alternate for proposed Site NT2-01J: *Chikyu* Expedition 319 (riserless)
Position:	33°13.0464′N, 136°36.319′E
Water depth (m):	2600
Target drilling depth (mbsf):	525
Approved maximum penetration (mbsf):	550
Survey coverage:	Extensive survey data from 3-D seismic data: • In-line 2624 • Cross-line 5306
Objective:	Drill and case long-term observatory hole
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319: • Wireline • LWD/MWD • Place sensors on bridge plug for later retrieval
Anticipated lithology:	Hemipelagic mud with turbidite sand, sedimentary breccia, and hemipelagic mudstone.

Site summaries (continued)

Contingency Site C0002 (former proposed Site NT3-01)

Priority:	Contingency: *Chikyu* Expedition 319 (riserless)
Position:	33°17.6′N, 136°38.6′E
Water depth (m):	1936
Target drilling depth (mbsf):	1000
Approved maximum penetration (mbsf):	1000
Survey coverage:	Extensive data from 3-d seismic data: • Track map (Fig. **AF1**) • In-line 2529 (Fig. **AF2**) • Cross-line 6225 (Fig. **AF3**)
Objectives:	• Drill and case long-term observatory hole • Take core samples at specific intervals
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319: • Wireline • LWD/MWD • Place sensors on bridge plug for later retrieval
Anticipated lithology:	

Site summaries (continued)

Contingency Site NT1-01A

Priority:	Contingency: *Chikyu* Expedition 319 (riser and riserless observatory) Primary: *Chikyu* Expedition 322 (subduction inputs)
Position:	32°44.8878′N, 136°55.0236′E
Water depth (m):	3610
Target drilling depth (mbsf):	600
Approved maximum penetration (mbsf):	800; approved by CDEX and TAMU safety panels based on EPSP January 2007 recommendation
Survey coverage:	Extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/600/**) and 3-D seismic data: • Track map (Fig. **AF4**) • Line ODKM03-AB (Fig. **AF5**) • Cross-line ODKM03-22 (Fig. **AF6**)
Objective:	See text for full details
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 319
Anticipated lithology:	Hemipelagic sediments, volcanic sediments, and basalt.

Figure AF1. Track map, Site C0002 (proposed Site NT3-01B). IL = in-line, XL = cross-line.

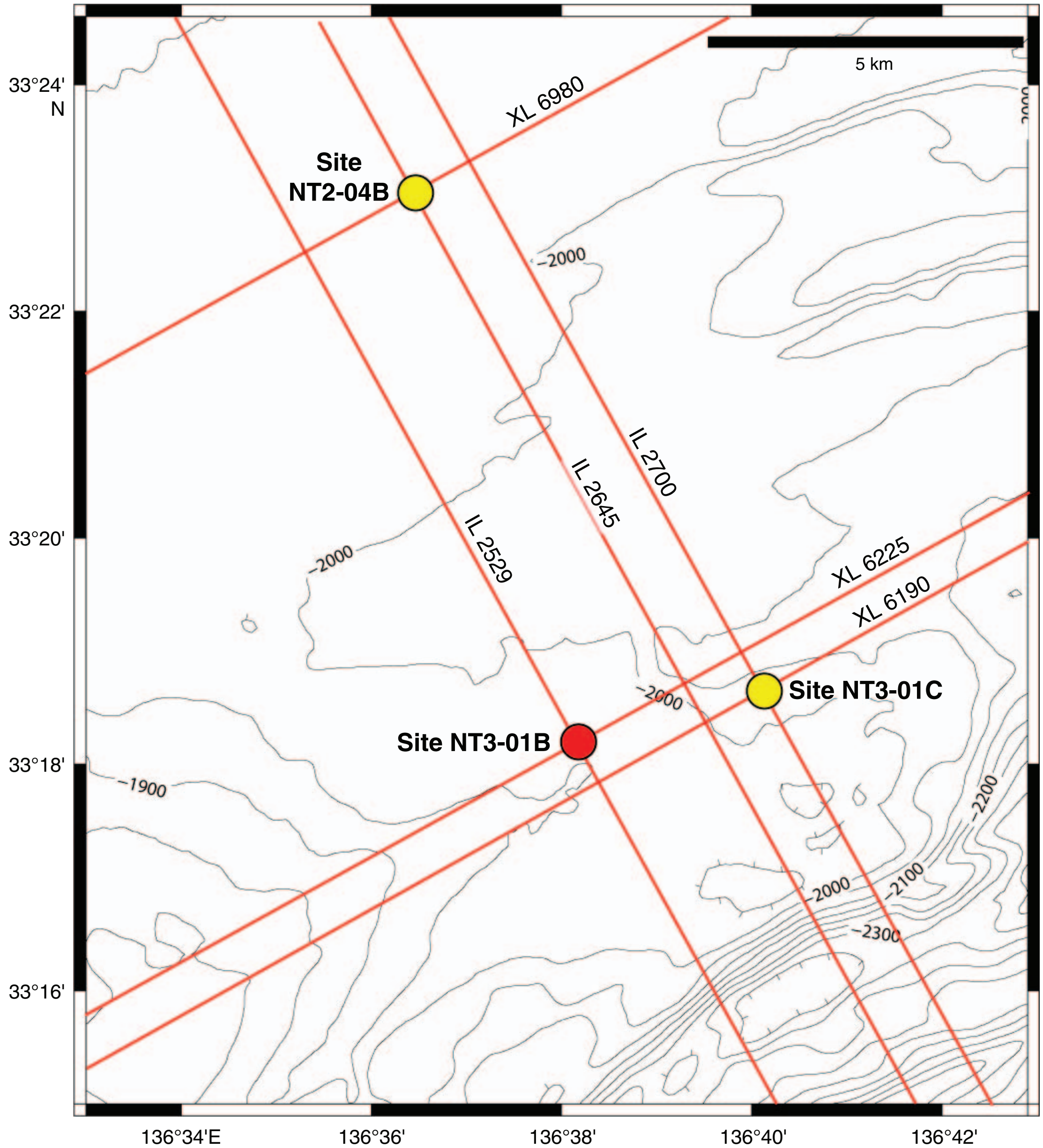


Figure AF2. In-line (IL) 2529. VE = vertical exaggeration.

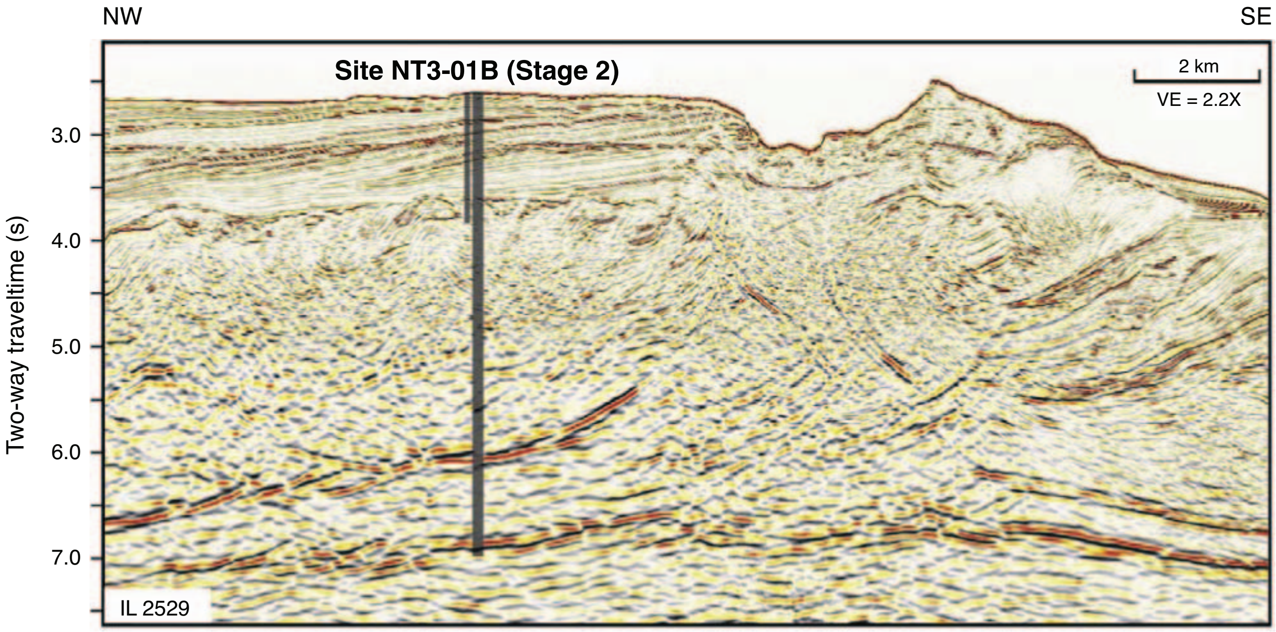


Figure AF3. Cross-line (XL) 6225. VE = vertical exaggeration.

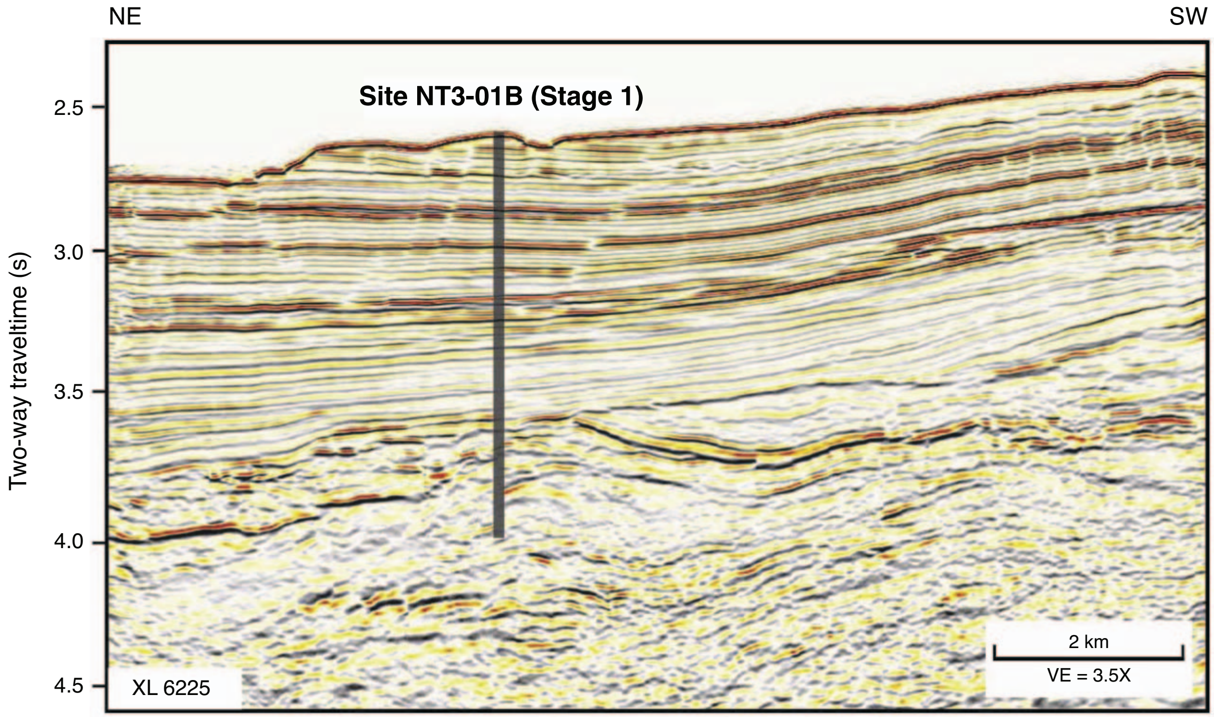


Figure AF4. Track map, Site NT1-01A.

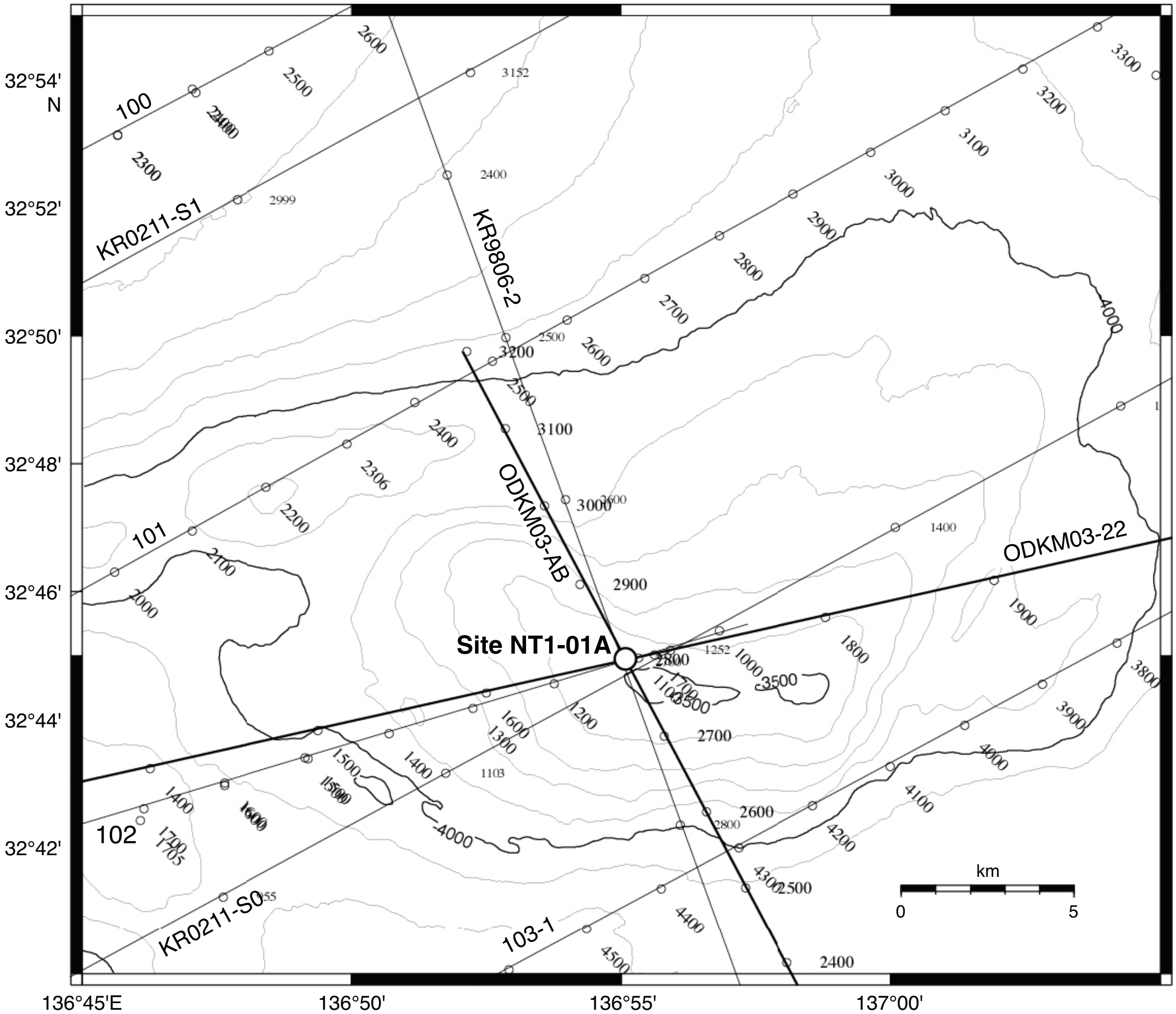


Figure AF5. Line ODKM03-AB. VE = vertical exaggeration.

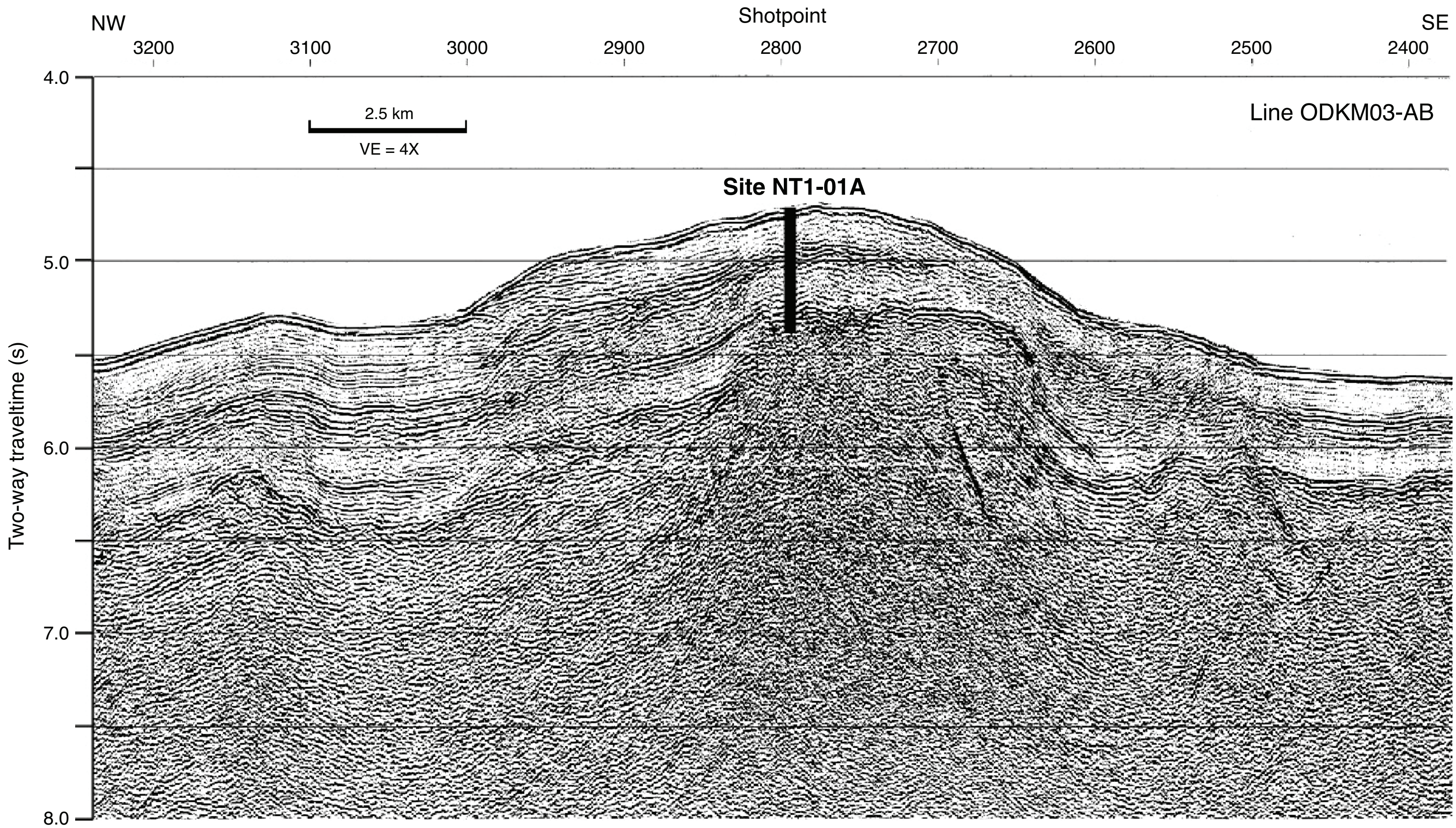
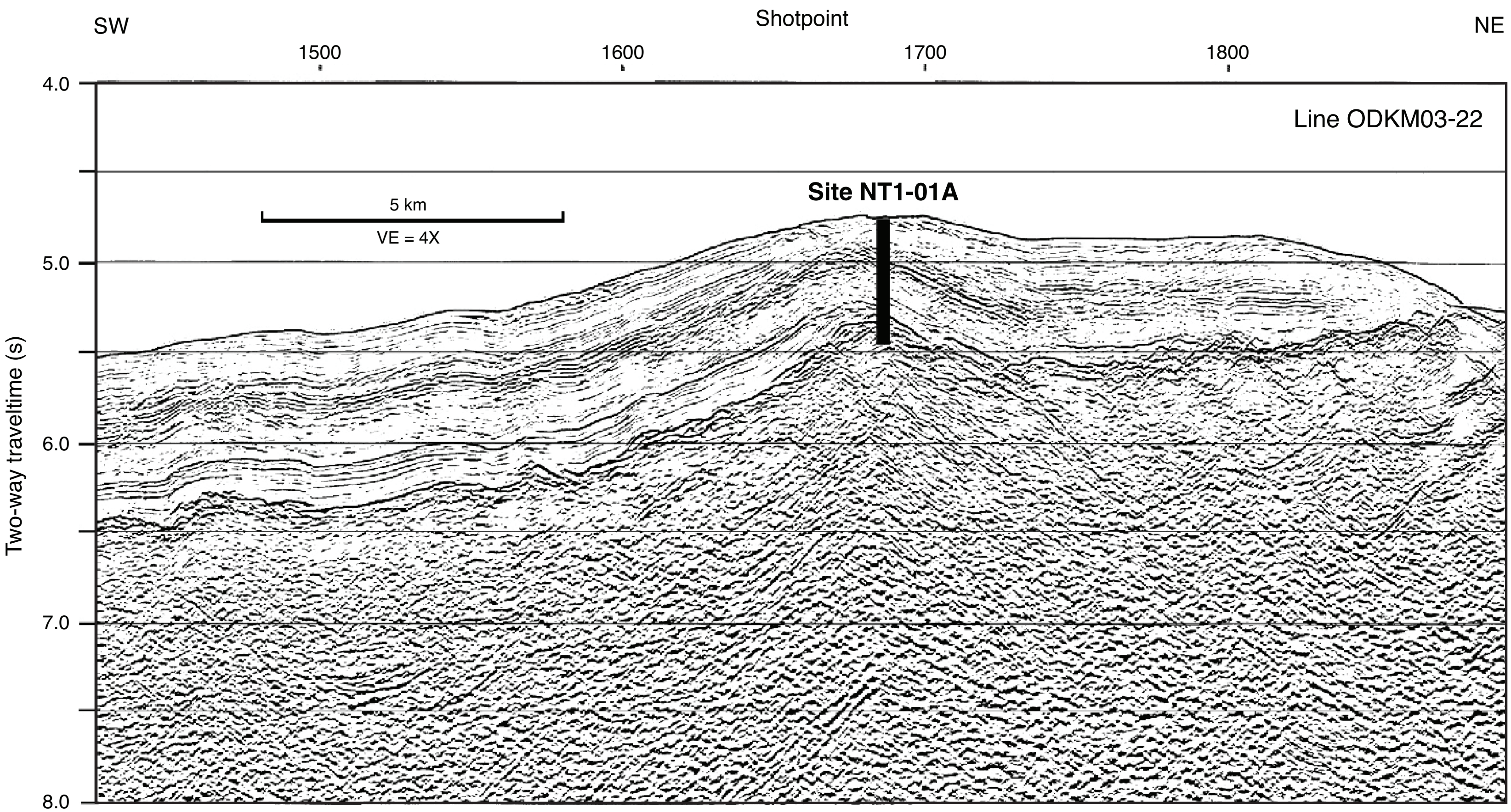


Figure AF6. Line ODKM03-22. VE = vertical exaggeration.



Scientific participants

The current list of participants for Expedition 319 can be found at **www.jamstec.go.jp/chikyu/eng/Expedition/NantroSEIZE/exp319.html.**