Integrated Ocean Drilling Program
Expedition 314 Scientific Prospectus

NanTroSEIZE Stage 1: NanTroSEIZE LWD Transect

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Published by
Integrated Ocean Drilling Program Management International, Inc.,
for the Integrated Ocean Drilling Program

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Citation:
Kinoshita, M., Tobin, H., and Thu, M.K., 2007. NanTroSEIZE Stage 1: NanTroSEIZE LWD transect. *IODP Sci. Prosp.,* 314. doi:10.2204/iodp.sp.314.2007

Distribution:
Electronic copies of this series may be obtained from the Integrated Ocean Drilling Program (IODP) Scientific Publications homepage on the World Wide Web at **www.iodp.org/scientific-publications**.

This publication was prepared by the Japanese Implementing Organization, Center for Deep Earth Exploration (CDEX) at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), as an account of work performed under the international Integrated Ocean Drilling Program, which is managed by IODP Management International (IODP-MI), Inc. Funding for the program is provided by the following agencies:

National Science Foundation (NSF), United States

Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan

European Consortium for Ocean Research Drilling (ECORD)

Ministry of Science and Technology (MOST), People's Republic of China

Korea Institute of Geoscience and Mineral Resources (KIGAM), Interim Asian Consortium

August 2007

Abstract

Integrated Ocean Drilling Program (IODP) Expedition 314 is part of the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE), an ambitious, coordinated, multiplatform and 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. During Expedition 314, our primary goals are to obtain a comprehensive suite of geophysical logs and other downhole measurements at six sites, using state-of-the-art logging-while-drilling (LWD) technology. All six of these sites are slated for continuous core sampling during subsequent IODP NanTroSEIZE expeditions. These sites include sampling of the incoming plate trench sediments, the frontal thrust and toe of the accretionary prism, forearc basin deposits, a major out-of-sequence thrust system (the “megasplay” fault), and highly-deformed rocks of the interior of the accretionary prism. The principal goals of the LWD program are to document in situ physical properties; stratigraphic and structural features; sonic to seismic scale velocity data for core-log-seismic integration; and stress, pore pressure, and hydrological parameters.

Depth objectives for this expedition range from ~600 to 1400 meters below seafloor. Logging plans are not final, pending negotiation with logging service companies, but we anticipate that the minimum measurements will include natural gamma radiation, azimuthal gamma ray density, neutron porosity, full waveform sonic velocity, azimuthal resistivity imaging, zero-offset vertical seismic profile, ultrasonic caliper, and annular fluid pressure.

In this *Scientific Prospectus* we present the scientific background and objectives, the drilling and logging operations designed to achieve them, a contingency plan strategy, the currently understood risks and steps taken to mitigate them, and the coordinated Stage 1 plan for sharing samples and data.

Schedule for Expedition 314

Expedition 314 is derived from the original Integrated Ocean Drilling Program (IODP) drilling Proposals 603-CDP3, 603A-Full2, 603B-Full2, 603C-Full, and 603D-Full2 (available at **www.iodp.org/NanTroSEIZE**). Following ranking by the IODP Scientific Advisory Structure (SAS), the IODP Operations Task Force created the NanTroSEIZE

Project Management Team (NT-PMT) to formulate a strategy for achieving the overall scientific objectives in these proposals. The resulting overall goals and multistage implementation strategy are described in Tobin and Kinoshita (2006a, 2006b). For the first stage of the NanTroSEIZE project, the IODP Operations Task Force scheduled three expeditions by the *Chikyu* (**www.iodp.org/expeditions**). These three expeditions will be implemented as a single science program. Additionally, core sampling at several sites and installation of a borehole observatory were planned as part of Stage 1, but expeditions to carry out these objectives have been deferred to a later time. The supporting site survey data for the NanTroSEIZE Stage 1 expeditions are archived at the IODP-MI Site Survey Data Bank (**ssdb.iodp.org**).

The expedition is currently scheduled to begin from Shingu, Japan, on 21 September 2007 and to end on 16 November 2007 with helicopter transfer of the science party from the ship to the Ugata, Shima, in the Mie Prefecture, Japan. A total of 57 days, including 8 days of pilot hole drilling and 15 days of contingency, will be available for the LWD operations described in this prospectus. At the time of publication, the ship schedule has not been finalized and may change (see Table **T1**). Refer to **www.iodp.org/expeditions** for more information. For the current detailed schedule, see **www.iodp.org**. Details on the *Chikyu* can be found at **www.jamstec.go.jp/chikyu**.

Introduction

NanTroSEIZE is a multiyear, multistage, and multiplatform effort planned for IODP. The first stage of NanTroSEIZE drilling operations will comprise three individual expeditions by the new riser-capable drilling vessel *Chikyu,* slated to begin September 2007. As each of the three Stage 1 expeditions have very different drilling targets and objectives, this *Scientific Prospectus* covers the objectives and operational plan for IODP Expedition 314 (LWD Transect).

The primary objectives of Expedition 314 are to obtain a comprehensive suite of geophysical logs and other downhole measurements at six sites, using state-of-the-art LWD technology. Three of these six sites are slated for continuous core sampling during the two subsequent IODP NanTroSEIZE Stage 1 expeditions scheduled to immediately follow Expedition 314. Coring at the other three sites is planned but currently deferred to a later time. Operations at the three sites (Figs. **F1, F2**) include sampling of the incoming plate trench sediments, the frontal thrust and toe of the accretionary prism, forearc basin deposits, a major out-of-sequence thrust (OOST) system, or megasplay fault, and highly deformed rocks of the interior of the accretionary prism. These sites are designed to accomplish the principal goals of the NanTroSEIZE Science Plan, including documenting the material inputs to the subduction conveyor (fluid, solids, and heat), the properties of major thrust faults and their wall rocks at depths shallower than ~1.4 km, the geology of the accretionary prism and overlying slope basin sediments, and installing a long-term monitoring system at proposed Site NT3-01 to record pore fluid pressure, temperature, seismic events, geodetic strain, and tilt over time (Tobin and Kinoshita, 2006; Kinoshita et al., 2006).

To begin Stage 1, we will acquire borehole LWD data by drilling dedicated holes with a drill string with the logging instruments incorporated into drill collars just above the drilling bit. A number of previous Ocean Drilling Program (ODP) and IODP expeditions have employed LWD technology.

Plans are subject to change, but at this time we plan to deploy Schlumberger LWD/measurement-while-drilling (MWD) tools including the following:

- geoVISION: records formation resistivity, including 360° borehole resistivity imaging and spectral natural gamma radiation
- adnVISION: mainly records porosity and neutron density
- sonicVISION: provides sonic *P*-wave velocity
- seismicVISION: records check shot vertical seismic profile (VSP) arrivals during LWD drilling and so provides interval velocity.

Additional measurements primarily intended for monitoring drilling conditions (MWD), such as torque, downhole weight on bit, and so on, as well as borehole pore fluid pressure (annular pressure while drilling [APWD]) will be recorded and also transmitted using MWD uphole telemetry.

Expedition 314 will be entirely dedicated to the LWD effort, and no coring or downhole measurement operations are planned. Some casing may be installed to facilitate deep penetration at several sites. Logging data will be analyzed initially by the Shipboard Scientific Party and will be made available to the scientific parties of the NanTroSEIZE Stage 1 expeditions.

Background

Geological setting

The Nankai Trough is a subducting plate boundary, where the Philippine Sea plate (PSP) underthrusts the southwestern Japan margin at a rate of ~4.1 cm/y along an azimuth of 310°–315°N (Seno et al., 1993) down an interface dipping 3°–7° (Kodaira et al., 2000). The subducting lithosphere of the Shikoku Basin was formed by backarc spreading at 15–25 Ma (Okino et al., 1994). The Nankai subduction zone forms an "end-member" sediment-dominated accretionary prism. In the toe region off Muroto, a sedimentary section ~1 km thick is accreted to or underthrust below the margin (Moore, Taira, Klaus, et al., 2001).

The three major seismic stratigraphic sequences identified in the northern Shikoku Basin are the lower and upper Shikoku Basin sequences and the Quaternary turbidite sequences (Fig. F3). The upper Shikoku Basin facies off Kumano decreases modestly in thickness toward the north, whereas the lower Shikoku Basin facies displays a much more complicated geometry as a result of the effects of basement topography (Le Pichon et al., 1987a, 1987b; Mazzotti et al., 2000; Moore et al., 2001). Seismic thickness decreases above larger basement highs and a more transparent acoustic character indicates local absence of sand packages that characterize most other parts of the lower Shikoku Basin. The mechanical differences between subducting basement highs and subducting basement plains could be significant for fault zone dynamics and earthquake rupture behavior.

The deformation front behavior off Kumano is fundamentally different than it is at Muroto or Ashizuri. Seismic reflection data off Kumano delineate the frontal fault clearly near the prism toe; however, there is little evidence for seaward propagation of the décollement within deeper Shikoku Basin strata (see Proposal 603A-Full2 **www.iodp.org/nantroseize-downloads**). One interpretation of the seismic profile is that the décollement steps up to the seafloor, thereby thrusting older accretionary prism strata (upper Shikoku Basin facies?) over the upper Quaternary trench-wedge facies (Fig. F3). Submersible observations also indicate that semilithified strata of unknown age have been uplifted and exposed along a fault scarp at the prism toe (Ashi et al., 2002). Farther inboard, the fault ramps down into the lower Shikoku Basin facies (Park et al., 2002).

The lower forearc slope consists of a series of thrust faults that have shortened the accreted sedimentary units of the accretionary prism. A combination of swath-bathymetric and multichannel seismic (MCS) data show a pronounced, continuous outer ridge (outer arc high) of topography extending >120 km along strike, which may be related to megasplay fault slip, including the 1944 Tonankai M 8.2 earthquake and repeated previous earthquakes. Remotely operated vehicle (ROV) and manned submersible diving surveys along this feature reveal a very steep slope on both sides of the ridge (Ashi et al., 2002, unpubl. data). The outer arc high coincides with the updip end of the splaying system of thrust faults that branch from a strong seismic reflector interpreted by Park et al. (2002) as a major OOST, which we term the "megasplay" because it is a feature that traverses the entire wedge and has had a protracted history shown by the thick forearc basin trapped behind its leading edge. The megasplay is hypothesized to represent the mechanical boundary between the inner and outer accretionary wedge and between aseismic and seismogenic fault behavior (Wang and Hu, 2006). At depth this megasplay is a high-amplitude reflector (Fig. **F2**), and it branches into a family of thrust splays in the upper few kilometers below the seafloor. Drilling into, sampling, and instrumenting this splay fault system at several locations downdip is a major goal of the NanTroSEIZE effort. Slip on the megasplay fault may thus be an important mechanism that accommodates strain resulting from relative plate motion and is the locus of some or all coseismic fault displacement.

The most direct evidence for recent megasplay fault activity comes from stratigraphic relationships at the tips of the faults in young slope sediments. Direct fault intersections with the seafloor are not observed; however, the thrust sheets wedge into these deposits, causing tilt and slumping of even the deposits nearest to the surface.

Other direct evidence that the megasplay fault has been active in geological to recent times comes from Kumano forearc basin stratigraphy. The Kumano Basin is characterized by flat topography at ~2000 m depth and is filled with turbiditic sediments to a maximum thickness of ~2000 m. Little is known regarding the detailed stratigraphy of the Kumano Basin, but several remarkable features are recognized in the seismic profiles (Fig. **F4**). The overall sedimentary sequences filling the basin can be divided into four main units by unconformities based on seismic reflection stratigraphy. The sediments in the southern part of the basin are tilted northward, truncated by a flat erosional surface, and subsequently cut by normal faults (Park et al., 2002). The depositional center appears to have migrated northward after each successive unconformity. The sequences above the unconformities are tilted less than those below the unconformities. All of the sediments pinch out toward the north. All of these features appear to be caused by uplift of the outer rise and potentially by postseismic relaxation after coseismic slip on the splay faults (Park et al., 2002).

Temperature is one of the key factors that affect frictional behavior at accretionary prism and thrusts. Heat flow data provide essential constraints on the thermal regime below the seafloor. Hyndman et al. (1997) estimate that the temperature near the updip limit of the Nankai asperity is ~150°C, based on heat flow data.

Heat flow on the trough floor offshore Kumano is ~100 mW/m^2 (Fig. **F5**). This is consistent with the theoretical heat flow estimated from the age of the subducting Shikoku Basin (~20 Ma off Kumano). However, a very rapid sedimentation rate can reduce the surface heat flow by up to ~15%, which eventually would affect the temperature of the plate interface. Heat flow on the trough floor is uniform at ~50 mW/m^2. There are a few locally elevated heat flow values at the cold seep community locations along OOSTs. The thermal regime in the accretionary prism is affected by the basal heat from the oceanic crust, thermal conductivity in the region, frictional heat along the megathrust, and radioactive heat sources. H. Hamamoto (pers. comm., 2007) numerically calculated the thermal structure using a code developed by Kelin Wang. He estimates the bottom hole temperature at proposed Sites NT2-03 (3500 meters below seafloor [mbsf]) and NT3-01 (6000 mbsf) to be 90°–100°C and 140°–150°C, respectively.

Previous drilling achievements

The Nankai accretionary prism has been one of the most intensively studied forearc regions in the world, by scientists using research vessels, submersibles, and scientific drilling. During the Deep Sea Drilling Project period (Legs 31 and 87) three sites were drilled off Cape Ashizuri, whereas in the ODP period, three legs (131, 190, and 196) were carried out in the Nankai Trough off Capes Muroto and Ashizuri (Moore et al., 2005). In 1990, seven holes were drilled at Site 808 during ODP Leg 131. During ODP Leg 190 (Moore et al., 2001), drilling was performed at six sites. During ODP Leg 196 (Shipboard Scientific Party, 2002a, 2002b), LWD operations and installation of a borehole observatory were conducted at revisited Site 808 (two holes) and at Site 1173 (two holes). The drilled holes provided essential information on the stratigraphy and physical properties of the strata deposited in the Shikoku Basin and initial accretionary processes.

As the dominantly hemipelagic strata are carried into the Nankai Trough, they are covered by a thick sequence of coarse terrigenous trench sediments, causing rapid consolidation of the Shikoku Basin strata. A décollement zone develops within the Shikoku Basin section. The upper Shikoku Basin section, along with the overlying trench sediments, are stripped off the PSP and added to the overriding plate, forming a wide accretionary prism. The lower Shikoku Basin strata are carried beneath the prism, where they continue to consolidate and dewater. Although the décollement zone could serve as a permeable channel along the subducting plate boundary, it also apparently forms a seal to the vertical transport of fluid, yielding a zone of overpressure at the top of the subducting section (Screaton et al., 2002).

The accreted strata form a classic fold and thrust belt at the toe of the prism. Approximately 75 km landward of the frontal thrust, a zone of OOST or splay faults cuts the prism. At this point, the décollement steps down to the top of the oceanic crust and the underthrusting Shikoku Basin strata may be added to the base of the prism (underplated). This point approximately coincides with the updip (seaward) limit of the seismogenic zone. Evidence of fluid migration up to the OOSTs, such as the presence of chemosynthetic clam colonies, has been found where the faults come to the surface (Ashi et al., 2002). Two holes that attempted to penetrate the faults (Leg 190 Sites 1175 and 1176) were drilled to hundreds of meters depth but were ultimately abandoned short of the fault reflectors because of the very poor core recovery in thick, poorly consolidated coarse sands.

LWD achievements during ODP Leg 196

During the first half of Leg 196, LWD operations were carried out at Sites 808 and 1173 (Shipboard Scientific Party, 2002a, 2002b). In Hole 1173B, LWD reached to basement at 737 mbsf. Here the LWD data verified a subtle porosity increase with depth from 122 to 340 mbsf, followed downhole by a sharp decrease in porosity and return to a normal consolidation trend. The sharp decrease in porosity correlated with the diagenetic transition from cristobalite to quartz in weakly developed grain cements and is marked by a strong seismic reflector that is reproduced well by a synthetic seismogram based on the LWD data. In Hole 1173B, resistivity-at-the-bit (RAB) images of the borehole show no evidence of a propagating protodécollement but, rather, reveal a basinal state of stress dominated by steeply dipping fractures and normal faults of variable strike (McNeill et al., 2004).

In Hole 808I, LWD reached just below the décollement zone (1035 mbsf), where poor drilling conditions precluded further penetration. Here, RAB images provide unparalleled structural and stratigraphic detail across the frontal thrust and décollement zones that indicate northwest–southeast shortening consistent with the seismic reflection data (Fig. F6A). RAB images also document borehole breakouts that show a northwest–southeast oriented maximum principal in situ stress direction, nearly parallel to the maximum principal stress direction inferred from microfaults in cores and from the plate convergence direction (Fig. F6B). Resistivity curves suggest that the frontal thrust zone has compacted, presumably a result of shearing. In contrast, the resistivity data suggest that the décollement zone is dilated (Bourlange et al., 2004). These resistivity anomalies in the frontal thrust and décollement zones cannot be explained by variations in pore water composition and need to be verified against the density and porosity logs after careful correction for borehole washouts.

Borehole hydrologic observatory at Nankai

Starting in the 1980s, ODP engineers and scientists developed instrumentation for long-term, in situ hydrological observatories called circulation obviation retrofit kits (CORKs) (e.g., Davis et al., 1992). CORKs have been deployed at the Middle Valley rift of the Juan de Fuca Ridge in 1991 (Davis and Becker, 1994) and the Cascadia and Barbados accretionary prisms.

Since CORKs allow only for a single seal measurement, scientific interest arose to include hydrological monitoring of multiple zones in a single hole, which has now been addressed with the advanced CORK (ACORK) (Becker and Davis, 1998). In 2001, ACORKS were installed for the first time in Holes 808I and 1173B during Leg 196 for a long-term monitoring experiment in the Nankai Trough accretionary prism (Shipboard Scientific Party, 2002a, 2002b). Drilling in Hole 808I penetrated the toe of the Nankai accretionary prism. Hole 1173B lies 13 km seaward and penetrates the sediments and uppermost igneous crust of the incoming plate. Based on the data obtained by ACORK, Davis et al. (2006) suggest a discrete episode of seismic and aseismic deformation of the Nankai Trough subduction zone accretionary prism.

Seismic studies/site survey data

The Kumano Basin region off the Kii Peninsula is among the best studied subduction zone forearcs in the world. 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; Nakanishi et al., submitted), passive seismicity (e.g., Obana et al., 2001), heat flow (Kinoshita 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 under contract by Petroleum GeoServices, an industry service company (Fig. **F1**). The poststack trace spacing is 12.5 m in the inline direction and 18.75 m in the crossline direction. This 3-D volume—the first deep-penetration, fully 3-D marine survey ever acquired for basic research purposes—has been used to refine the selection of drill sites and targets in the complex megasplay fault region and to define the regional structure and seismic stratigraphy. As drilling proceeds, the 3-D seismic data will continue to be used to analyze physical properties of the subsurface through seismic attribute studies, to expand findings in the boreholes to wider areas, and to assess drilling safety. In addition, in early 2006, Japan Agency for Marine-Earth Science and Technology–Institute for Frontier Research on Earth Evolution (JAMSTEC-IFREE) collected a small area of narrow-width 3-D reflection data over the reference and frontal thrust site transect (Park et al., 2006) (Fig. **F1**). The supporting site survey data for the NanTroSEIZE Stage 1 expeditions are archived at the IODP-MI Site Survey Data Bank (**ssdb.iodp.org**).

Scientific objectives

Overall objectives

Tobin and Kinoshita (2006a, 2006b) provide the overall goals and plans of the NanTroSEIZE project as a whole, and the reader is referred to those publications for details. Here we briefly summarize the overall goals.

IODP will attempt to drill into, sample, and place instruments into the seismogenic portion of a plate boundary fault, or megathrust, within the Nankai Trough subduction zone in the offshore Kumano-nada region, near the Kii Peninsula of Honshu Island (Fig. **F1**). The most ambitious objective is to access, sample, and place instruments into the Nankai plate interface within the seismogenic zone using riser drilling at proposed Sites NT2-03 and NT3-01 at depths of ~3500 and ~6000 m, respectively (Fig. **F2**). The science plan entails sampling and long-term instrumentation of the following:

- The inputs to the subduction conveyor belt,
- Faults that splay from the plate interface to the surface and that may accommodate a major portion of coseismic and/or tsunamigenic slip, and
- The main plate interface at a depth of as deep as 6000 m.

Conditions for stable versus unstable sliding, which define seismic versus aseismic behavior, have long been the subject of research and debate, as has the frictional strength of likely fault zone material. Fault zone composition, consolidation state, normal stress magnitude, pore-fluid pressure, and strain rate may affect the transition from aseismic to seismic slip (e.g., Saffer and Marone, 2003). At NanTroSEIZE, we will sample the following:

- Fault rocks over a range of pressure and temperature conditions across the aseismic–seismogenic transition,
- The composition of faults and fluids and associated pore pressure and state of stress, and
- The in situ physical properties of the subduction zone forearc environment through logging and downhole measurements.

We will also install a series of borehole observatories to provide in situ monitoring of these critical parameters (seismicity, strain, tilt, pressure, and temperature) over time and test whether interseismic variations or detectable precursory phenomena exist prior to great subduction earthquakes. The overarching hypotheses to be addressed are as follows (refer to the Complex Drilling Program [CDP] proposal document at **www.iodp.org/NanTroSEIZE** for more details):

1. Systematic, progressive material and state changes control the onset of seismogenic behavior on subduction thrusts.
2. Subduction zone megathrusts are weak faults.
3. Within the seismogenic zone, relative plate motion is primarily accommodated by coseismic frictional slip in a concentrated zone.
4. Physical properties, chemistry, and state of the fault zone change systematically with time throughout the earthquake cycle.
5. The megasplay (OOST) thrust fault system slips in discrete events, which may include tsunamigenic slip during great earthquakes.

Sediment-dominated subduction zones such as the East Aleutian, Cascadia, and Nankai margins are characterized by repeated occurrences of great earthquakes of ~Mw 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 along the outer high (e.g., Byrne et al., 1988; Wang and Hu, 2006). At Nankai, high-resolution images of the outer high from seismic reflection profiles clearly document a major OOST fault system that branches from the plate boundary décollement within the coseismic rupture zone of the 1944 Tonankai M 8.2 earthquake and splits into several subsplays near the seafloor (Park et al., 2002) (Fig. F2). As stated above in the fifth hypothesis, one of the first-order goals in characterizing the seismogenic zone along the Nankai Trough, and which bears on understanding subduction zone megathrust behavior globally, is therefore to document the role of the megasplay fault in accommodating plate motion and characterize its mechanical and hydrologic behavior. The NanTroSEIZE strategy is to drill into the basal décollement fault at two locations and the megasplay fault system at three locations to comprehensively study the updip transition from aseismogenic to seismogenic fault activity.

Scientific objectives of Stage 1

During the development of the NanTroSEIZE drilling proposals, it was recognized from the outset that achieving these very ambitious goals would require a carefully planned and managed effort over multiple years and a number of individual drilling expeditions. The IODP SAS accordingly developed a new designation, the CDP, to recognize the need to organize multiple expeditions for a unified scientific purpose. The three *Chikyu* expeditions now planned for 2007 to early 2008 and the deferred operations described above comprise Stage 1 of the NanTroSEIZE CDP. Expedition 314 is the first of these three and is dedicated to acquiring high-quality downhole logging information from the six drill sites planned for Stage 1 as a whole. The Stage 1 overarching prospectus (Tobin and Kinoshita, 2006b) describes the overall NanTroSEIZE objectives and unified Stage 1 plan in greater detail, and readers should familiarize themselves with this plan.

In brief, Stage 1 of the NanTroSEIZE program includes three coordinated riserless drilling expeditions to drill at several sites across the continental slope and rise offshore the Kii Peninsula, within the inferred coseismic slip region of the 1944 Tonankai M 8.2 earthquake (Figs. F1, F2) (Tobin and Kinoshita, 2006a, 2006b). This prospectus is concerned with the first of these, an all-LWD expedition to all of the Stage 1 drilling sites to define physical properties, lithostratigraphy, and structural information in advance of coring operations. Detailed plans are described in the following sections. This will be followed by a coring expedition (Expedition 315, Megasplay Riser) aimed at sampling the materials and characterizing in situ conditions within the accretionary wedge to a depth of ~1000 mbsf at proposed Site NT2-03. This site will also serve as a pilot hole for later Stage 2 riser drilling targeting the megasplay fault at ~3000–

3500 mbsf. A third riser *Chikyu* expedition (Expedition 316, Shallow Megasplay and Frontal Thrusts) targets two shallow fault zones: (1) the frontal thrust near the trench (proposed Site NT1-03) and (2) the older accretionary prism and megasplay fault at ~1000 mbsf (proposed Site NT2-01). Two additional NanTroSEIZE riserless expeditions, originally scheduled for the *JOIDES Resolution* during FY2007 but now removed from the schedule, sought to characterize the sedimentology, physical properties, hydrogeology, and in situ conditions of the incoming sediment and ocean crust at proposed Sites NT1-01 and NT1-07 and will document the long-term slip history of the megasplay fault at proposed Site NT3-01 based on stratigraphic relationships in the Kumano forearc basin by sampling ~1000 m of basin sediments and as much as 300 m of the underlying accretionary wedge. See **www.iodp.org/expeditions** for updated information on the dates of these expeditions.

Specific scientific objectives of Expedition 314

Expedition 314, slated to be *Chikyu's* first IODP expedition, will kick off NanTroSEIZE Stage 1 activities with a dedicated drilling and logging program, using LWD technology at all six Stage 1 sites. The overall science plan calls for continuous coring, downhole measurements, and geophysical logging at all Stage 1 sites. In the typically unstable formations associated with riserless drilling in the accretionary prism environment, LWD is the only option to obtain high-quality geophysical logs, as demonstrated at other convergent plate margins during ODP Legs 156 and 171A (North Barbados Ridge), 170 and 205 (Costa Rica), and 196 (Nankai Muroto transect). Note that the full set of LWD tools cannot be run simultaneously with coring, so *no coring is planned for this expedition.* For operational and budgetary efficiency, the LWD logging portion of the science plan for all six proposed sites has been grouped together to form this stand-alone expedition, whereas coring and other activities will take place on the two subsequent Stage 1 expeditions and one expedition in the future.

LWD technology permits logging in these challenging environments because holes are drilled rapidly and continuously, without slow coring operations, and because the logging data are recorded just behind the bit when the hole has been freshly cut and conditions are as close to in situ as possible. The planned LWD operation for all sites during Expedition 314 consists of drilling one or more holes at each site by continuously washing down at a controlled rate with the logging tools incorporated into the bottom-hole assembly from 1 to ~40 m above the drill bit. The logging data are therefore acquired very soon after the hole is cut, providing the best possible data quality. The majority of the data are recorded in memory mode downhole and are downloaded after the drill string is brought back on board; however, some limited-resolution MWD data will be transmitted to the surface in real time. LWD logging measurements now planned for Expedition 314 will include spectral natural gamma radiation, resistivity, gamma density and neutron porosity, 360° borehole resistivity and density imaging, sonic velocity, interval seismic velocity, and APWD. Additional data to be recorded include logs for quality assessment and environmental correction (mud temperature, mud resistivity, etc.) as well as drilling parameter logs such as weight-on-bit and torque. More detailed information about the logging instruments to be deployed is given in **"Measurement and logging-while-drilling tool capabilities."**

Site by site logging-while-drilling plans for Expedition 314

Proposed Site NT1-01

Proposed Site NT1-01 targets the Shikoku Basin sedimentary section in a location where it has been deposited on a prominent basement high (Fig. **F7**). Characterization of the sediments, fluids, and basement composition at this site is part of a two-part strategy to document the material inputs to the seismogenic zone. Our plan is to drill proposed Site NT1-01 on a basement high and proposed Site NT1-07 in a thicker section off that high in order to show how basement relief influences the presubduction geometry of sedimentary facies, temperature, permeability, sediment and basement alteration, and fluid flow. Significant preexisting relief on the Shikoku Basin igneous crust has affected the distribution of sediments; therefore, the lithostratigraphy and fluid content of the sediment column vary spatially. In particular, most of the basin area includes a large proportion of turbidites in the deeper part of the stratigraphic column, but basement highs lack much or all of this deep turbidite section, based on seismic data analysis. Presence or absence of these facies and attendant fluid and smectite clay content may strongly affect downdip physical properties and initial conditions as sediments enter the seismogenic zone. Basement highs have been suggested to act as asperities in earthquake slip.

The program of LWD at these two sites (along with subsequent coring and observatory installation in the future) will quantify initial conditions in the material that is tectonically delivered to the subduction system; this material ultimately is what enters the seismogenic zone and initially hosts fault slip. Key scientific themes for proposed Site NT1-01 LWD will include deepwater turbidite depositional system and facies architecture through integration of logs with 3-D seismic data and physical properties (especially porosity and density to quantify mass flux) of the anticipated hemipelagic and turbidite sediments.

LWD of the entire sediment section to just above the top of basement is planned, to an estimated depth of ~600 mbsf (IODP Environment Protection and Safety Panel [EPSP] approved maximum penetration at this site is 800 mbsf). Because we wish to preserve basement hydrologic conditions in anticipation of observatory installation during a subsequent stage, no basement penetration is planned for this site with LWD.

Proposed Site NT1-07

Paired with proposed Site NT1-01, proposed Site NT1-07 targets the incoming section, as described above. At this location off the basement high, the deep portion of the Shikoku Basin section includes reflectors interpreted as regionally extensive deepwater turbidites (Fig. **F8**). LWD drilling of the entire sediment section to the top of basement is planned, at an estimated total depth of ~1200 mbsf (EPSP approved maximum penetration at this site is 1200 mbsf). As with proposed Site NT1-01, no basement penetration is planned for LWD operations during this stage.

Proposed Site NT1-03

Proposed Site NT1-03 targets the main frontal thrust at the toe of the entire accretionary wedge (Fig. **F9**). Based on seismic data and submersible dive studies (Ashi et al., 2002), this thrust is thought to have placed moderately consolidated clastic rocks over the weak and unlithified late Quaternary trench section clastic sediments. Propagation of an underlying décollement zone into the trench section is not clearly imaged, raising the hypothesis that this frontal fault is the main detachment, which, in this case has propagated all the way to the seafloor. On the other hand, detailed analysis of the seismic data suggests that substantial footwall deformation exists in the first few hundred meters below the fault at this site location, implying that strain decoupling is not total across this fault. Reflection amplitude of the fault plane is variable near this site, but generally it is a negative polarity reflector.

The overall objectives of drilling at proposed Site NT1-03 are comprehensive characterization of the lithology, deformation, and physical properties of the wall rocks and the fault zone, as well as documentation of the fluid chemistry. LWD drilling will contribute in situ physical properties and borehole imagery for this characterization. Drilling is planned to ~600–900 mbsf in a faulted turbidite and hemipelagic sediment setting, with the fault zone targeted at 350–400 mbsf (EPSP approved maximum penetration at this site is 1800 mbsf). A substantial porosity and velocity inversion is anticipated beneath the frontal thrust fault reflector. Later stages of drilling may target deeper intervals beyond 600 mbsf at this site, depending on what is discovered during Stage 1.

Proposed Site NT2-01

Goals at proposed Site NT2-01 entail LWD drilling of ~1000 m (EPSP approved maximum penetration at this site is 1200 mbsf) of the midslope region, across at least one major strand of the megasplay fault system (Fig. **F10**). This site will begin the downdip transect of the megasplay fault system by sampling a relatively shallow, presumably aseismogenic point on the fault zone at ~800 mbsf. The anticipated lithology is deformed terrigenous sediment, faults, and possible gas hydrate, though there is no clear bottom-simulating reflector (BSR) at this site. Beneath the near-surface slope deposits, the acoustically transparent zone above the reflective thrust fault may be composed of highly deformed and faulted accretionary mélange and/or disrupted stratigraphy of slope deposits. This material may have been transported a substantial distance up the splay thrust, in which case it would be likely to be anomalously well consolidated for its depth, with attendant low porosity and high density and seismic velocity. Beneath the fault reflector, 3-D seismic data suggest we will penetrate deformed but stratigraphically intact slope sediments that have been overridden by the splay thrust fault.

As with proposed Site NT1-03, the logging data will be used to characterize the material properties, deformational features, and conditions in the fault zones, wall rocks, and sediments. The logging data will guide coring operations during the subsequent Expedition 315, as well as subsequent installation of a pore pressure and strain monitoring system during Stage 2.

Proposed Site NT2-03

LWD drilling at proposed Site NT2-03B targets the uppermost 1000 mbsf (EPSP approved maximum penetration at this site is 1250 mbsf) at the seaward edge of the Kumano Basin uplift (outerarc high) where the megasplay fault system branches and approaches the surface (Fig. **F10**). Stage 1 drilling at this site is the first phase of a two-part strategy. The ultimate objective is to perform riser drilling to ~3500 mbsf during Stage 2, across the megasplay fault at depth, and establish a long-term deep borehole observatory. The upper 1000 m to be drilled during this expedition provides an opportunity to access the thrust sheets uplifted by several branches of the megasplay fault, as well as a thin overlying slope basin cover sequence. The nature of the material in these thrust sheets is unknown. As with proposed Site NT2-01, the acoustically nonreflective nature of this section suggests that it may be composed of chaotically deformed accretionary wedge sedimentary mélange transported from significantly greater depth. Alternatively, this zone may be composed of highly deformed Kumano forearc basin sediments. Possibly, it is a structurally juxtaposed combination of both. Together with later core samples, logs from this zone will discriminate among these possibilities and provide data on physical properties, strength, composition, and structure of the hanging wall of the main megasplay branch. It is likely that the upper 1000 m of drilling at this site will also penetrate one or more subsidiary splay branches near the updip end of the splay system, affording an opportunity to compare fault development with proposed Site NT2-01.

Stage 1 LWD will also provide critical "pilot hole" information for later riser-based drilling. To achieve the ~3500 m total depth objective using the riser and weighted drilling mud involves setting multiple casing strings, the depth of each of which depends on the least principal stress, fracture strength of the formation, and pore fluid pressure gradient. The key part of this casing plan is the "top-hole" portion, where tolerances on mud weight are tight. Planning the casing program, therefore, requires excellent information on physical properties in the uppermost 1000 mbsf. In light of this, our strategy is to utilize riserless drilling for this section in Stage 1 in this pilot hole and then return for the deeper portion in Stage 2.

Proposed Site NT3-01

At proposed Site NT3-01, we plan LWD drilling of as deep as 1400 mbsf (EPSP approved maximum penetration at this site) of the Kumano forearc basin section and the underlying formations, interpreted as older rocks of the accretionary prism and/or early slope basin sediments deposited prior to the development of the megasplay fault and the Kumano Basin (Figs. **F11**, **F12**). Scientific objectives include investigation of the outer forearc basin depositional systems, including possible earthquake-triggered turbidites, convergent margin deformation, likely gas hydrate, and a BSR. This is the site slated for deep drilling across the entire plate boundary system to >5500 mbsf during Stage 3 riser drilling. Expedition 314, along with later coring in the future, will accomplish the following:

- Document the depositional and uplift history of outer Kumano Basin sediments, which will shed light on the long-term slip history of the megasplay fault system and deformation in the accretionary prism;

- Sample the interior of the accretionary prism in the midslope region;
- Establish a thermal gradient structure at the position of the updip limit of coseismic slip; and
- With LWD logs, provide critical physical properties information for planning for an observatory to be installed in a later stage and also for Stage 3 riser drilling and casing plan to achieve the >5500 mbsf depth objectives across the entire plate boundary.

Plans include continuous logging of the entire sedimentary section through the Kumano Basin and as much of the underlying older accretionary wedge rocks as possible to 1400 mbsf. Depth to the base of the Kumano Basin section is estimated to be ~900 mbsf, based on preliminary 3-D prestack depth migration velocities. The objective is to penetrate to this unconformity and 100–300 m below it to sample the underlying formation. Characterization of seismic velocity, density, porosity, stress, rock strength parameters, and pore pressure are all high priorities.

Logging-while-drilling objectives

The overarching objective of the LWD program is to provide borehole data that will be used in conjunction with cores to document the geology, physical properties, mechanical state, fluid content, and stress conditions at the drilling site locations. Specifically we want to document the following:

- **Physical properties:** We plan to record density, porosity, resistivity, and sonic velocity for each borehole. These will provide key in situ information that, together with the core-based sample data, will be used to quantify the mass and materials that make up the Nankai margin. Drilling targets for which physical properties are especially relevant include zones of anomalous compaction state, gas hydrate BSRs and fault zones, and adjacent wall rocks.
- **Lithology:** We will also record spectral gamma radiation data. Together with the logs described above, these data can be used to develop an integrated log-based lithostratigraphy.
- **Structural geology:** Borehole imaging logs, principally the azimuthal resistivity and azimuthal density, permit mapping of bedding dip, fracture presence and orientation, and other rock fabric data. These will be useful in conjunction with core data to develop a complete structural description, including in situ orientation of structures.

- **In situ fluid pressure and stress:** Borehole imaging logs can also detect borehole breakouts and induced fractures (e.g., McNeill et al., 2004; Wu et al., 2007), useful for determining the orientation of the present-day horizontal principal stresses. The APWD log is primarily a drilling parameter measurement, as it measures the fluid pressure in the open borehole near the bit; however, it can be an indicator of steep gradients in formation pressure or other anomalies. Sonic velocity is potentially another indirect indicator of stress conditions.
- **Core-log seismic integration:** Several of the logs will provide key information for creating synthetic seismograms that tie 3-D seismic attributes to cores and borehole depth. The "seismic-while-drilling," or check shot–style VSP is principal among these, providing borehole depth ties at similar wavelengths to that of the MCS data.
- **Drilling conditions:** APWD, downhole weight-on-bit, torque, drilling rate, and other parameters are primarily used to assess the drilling conditions. These measurements, however, can provide useful information about formation strength and other environmental variables relevant to the scientific objectives and also relevant for planning the well drilling and casing program for subsequent riser drilling.

Drilling strategy

To achieve the overall scientific objectives of the NanTroSEIZE project, drilling is planned at eight sites. As many as three sites target the incoming plate section, one will sample the frontal thrust of the accretionary wedge, two sites target the megasplay fault system at different depths, one site will sample the megasplay uplift history recorded in the forearc basin sediments, and one ultradeep site targets the plate interface in the seismogenic zone. NanTroSEIZE Stage 1 calls for drilling and sampling in riserless mode at six of the sites, including the following:

- The incoming sediments of Shikoku Basin (two sites),
- The frontal thrust system at the toe of the accretionary wedge,
- The midwedge megasplay fault system, and
- Approximately 1000 m deep holes at the two sites planned for later deep penetrations of the seismogenic zone faults (two sites).

Primary drill sites

During Expedition 314, the order of drilling at the six sites is determined by scientific priority and operational difficulty. The full set of LWD/MWD tools will first be deployed at proposed Site NT1-01A at the far southeast of the Kumano Basin in the Nankai Trough. An LWD/MWD hole at proposed Site NT1-01A will be drilled to the top of basement at an estimated depth of 600 mbsf. Next, proposed Site NT2-03B is to be drilled into the upper thrust sheet and through a possible fault zone at ~800 mbsf to a total depth of 1000 mbsf or greater. The third site, proposed Site NT3-01B, is located in the Kumano forearc basin. This site is a pilot for the deep riser drilling in later stages. To facilitate achievement of the 1400 m deep objective, installation of casing is planned for the upper 1000 m before drilling deeper. This will require that LWD logging be conducted in two or more separate runs. Proposed Site NT2-01B is located at the shallower part of the megasplay OOST thrust system at the outer arc high and is planned to reach a maximum depth of 1000 mbsf, passing through the splay fault reflector at ~800 mbsf and continuing ~200 m into the footwall silts and clays of the accretionary prism. Next, we plan to drill the frontal thrust site, proposed Site NT1-03A, to a depth of as much as 1000 mbsf, though only 950 m of drilling is currently scheduled. Finally, we plan to turn to proposed Site NT1-07A in the incoming sediments of the Shikoku Basin, where the plan is to drill ~1200 m to reach the top of the oceanic crustal rocks of the basement.

In the event that drilling conditions are difficult at proposed Sites NT2-01B and NT2-03B, casing will be available as a contingency for the upper 600 m. For planning purposes, this casing plan is included in the operation time estimate at proposed Site NT2-03 (Table **T1**), but not at proposed Site NT2-01; however, this contingency covers drilling at both sites.

Contingency/alternate sites

A total of 15 contingency days are factored into the expedition for time lost as a result of weather, equipment, and drilling. If the LWD operations at the primary sites are completed ahead of schedule or if operations at one of the primary sites cannot be completed because of currents or other difficulties, then drilling may be conducted at (1) an additional site, proposed Site NT2-04 (Fig. **F13**), and (2) proposed Site NT1-03 to greater depth in order to reach farther into the deformed footwall of the frontal thrust, since EPSP has approved penetration at this site to as deep as 1800 mbsf. If the LWD operations are behind schedule, drilling may stop at shallower depths than the target depth at proposed Site NT2-03 and all other sites, as needed. In addition, most of the primary sites are accompanied by one or more approved backup sites (e.g., proposed Site NT2-03C; see **"Site summaries"** for details). In the event that the primary site is deemed unsuitable, either before or during operations at that site, then drilling at the respective backup sites will become the first alternative strategy.

Logging strategy

Difficulties in attempted wireline logging during previous legs at Nankai and other accretionary prisms and, conversely, the successful experience of Leg 196 (Mikada, Becker, Moore, Klaus, et al., 2002) at Nankai clearly indicate that LWD is required to acquire in situ physical properties data in the Nankai accretionary prism. LWD surveys have been very successful in obtaining logs from active prisms during the following ODP legs and IODP expeditions:

- Leg 156: North Barbados Ridge, tropical northwest Atlantic (Shipley, Ogawa, Blum, et al., 1995)
- Leg 170: Costa Rica convergent margin, equatorial northeast Pacific (Kimura, Silver, Blum, et al., 1997)
- Leg 171A: North Barbados Ridge, tropical northwest Atlantic (Moore, Klaus, et al., 1998)
- Leg 196: Nankai Trough northwest Pacific (Mikada, Becker, Moore, Klaus, et al., 2002)
- Legs 174A: New Jersey shelf, northwest Atlantic (Austin, Christie-Blick, Malone, et al., 1998)
- Leg 188: Prydz Bay, Antartic (O'Brien, Cooper, Richter, et al., 2001)
- Leg 193: Manus Basin, Bismarck Sea (Binns, Barriga, Miller, et al., 2002)
- Leg 204: Hydrate Ridge-Cascadia margin, northeast Pacific (Tréhu, Bohrmann, Rack, Torres, et al., 2003)
- Leg 209: Mid-Atlantic Ridge, tropical northwest Atlantic (Kelemen, Kikawa, Miller, et al., 2004)
- Expedition 308: Brazos Trinity Basin, Gulf of Mexico (Flemings et al., 2006)
- Expedition 311: Cascadia Margin gas hydrates, northeast Pacific (Riedel et al., 2006)

During Expedition 314, we will employ both LWD and MWD technologies. LWD and MWD tools measure different parameters. LWD tools are formation evaluation tools while drilling; they measure formation properties with instruments located in the drill collars above the drill bit. MWD tools are also located in the drill collars and measure downhole engineering drilling parameters (e.g., weight on bit, torque, etc.). Another function of the MWD tool is transmitting real-time MWD data and a limited set of LWD data through drilling fluid inside the drill pipe by means of a modulated pressure wave, or mud pulsing, which is then monitored in real time at the rig floor. Most LWD data, at least those of highest resolution and thus larger size, are recorded in memory at the downhole tool and retrieved when the tools reach the surface. For safety monitoring purposes, the MWD tool will be coupled with APWD for all holes drilled during this expedition. MWD tools enable both APWD and MWD data to be transmitted uphole when the tools are used in conjunction, along with a subsampling of the LWD data. The term “LWD” is often used generically for LWD and MWD-APWD measurements.

Logging data complement core-based information because they are continuous and not subject to core recovery. Additional parameters or scales of investigation can also be measured. We are planning to deploy the following Schlumberger MWD and LWD instruments (**www.slb.com/content/services/drilling/imaging/index.asp**):

- APWD
- Azimuthal density neutron (adnVISION)
- geoVISION resistivity
- sonicVISION and seismicVISION (Fig. **F14**).

To ensure good resistivity image resolution and gamma ray data quality, ~20–30 m/h rate of penetration is required.

Measurement and logging-while-drilling tool capabilities

Density and porosity

The adnVISION tool includes neutron porosity measurement and induced gamma density. It is an azimuthal measurement and provides 16 sector borehole density images. The sector data are subsequently grouped into four quadrants (up, down, left, and right), oriented with internal magnetometers. For proper environmental corrections, the adnVISION will also measure standoff from the tool to the borehole wall in quadrants using an ultrasonic caliper.

Resitivity and resistivity imagery

The geoVISION resistivity tool is based on RAB technology, which was designed to provide real-time at-bit resistivity data, and provides azimuthally focused laterolog measurements for detailed geological mapping. The sensors include ring and bit resistivity and three azimuthally oriented focused button electrodes for imaging capabilities. The three button electrodes are ~1 inch in diameter and are longitudinally spaced along the axis of the tool. The spacing provides multiple depths of investigation for quantifying invasion profiles and fracture identification (drilling induced versus natural). These azimuthally acquired button measurements are displayed as full-bore images to graphically describe formation resistivity. For environmental correction of the resistivity measurements, drilling fluid resistivity and temperature are also measured.

Natural gamma radiation

The spectral gamma radiation detector included in the geoVISION tool measures and classifies natural radioactivity in the formation and provides a common reference for correlation and depth shifting between multiple logging (LWD and wireline logging) runs and core data.

Sonic velocity

The sonicVISION sonic-while-drilling tool delivers real-time interval transit time data for compressional waves. Measurement range is given between 40 and 230 µs/ft (1.3 and 7.6 km/s) depending on mud type, but intensive processing is required to obtain reliable sonic velocity measurements in the relatively slow formations expected during Expedition 314. In LWD operations the sonic processing parameters are conventionally set at the surface, before the tool is run in the hole. This results in possible mislabeling of arrivals (especially for slow formations) and limited confidence levels, as only the end result of downhole processing is seen uphole in the real-time log. Full waveform data are recorded in memory, however. Advanced onboard postprocessing should allow fine tuning of sonic acquisition parameters and so extend the range of measurement out to the mud velocity, a key feature for achieving the scientific objectives of this cruise, including log-seismic ties. Additional quality control (QC) is performed using automatic station measurements made during a pipe connection. In this noise-free environment, the tool is able to take a “station” measurement that is then sent uphole, when pumping resumes, for further QC of the real-time log.

Zero-offset vertical seismic profile

The seismicVISION LWD system delivers time depth/velocity information to provide interval velocity. The seismicVISION tool, which contains a processor and memory, receives seismic energy from a conventional air gun suspended from a crane on the drillship. After acquisition, the seismic signals are stored and processed downhole, and check shot data and quality indicators are transmitted uphole in real time via connection with the MWD pulse system. Waveforms are recorded in the tool memory for further processing after a bit trip.

Organization of scientific party

In order to cover the above-mentioned objectives and make full use of collected data, the scientific party of Expedition 314 will be organized into five groups, respectively devoted to the following:

1. Safety monitoring and logging data quality checks and log characterization;
2. Lithostratigraphy (identification of logging units through visual interpretation and multivariate statistical analysis, lithological interpretation, and sedimentary facies characterization);
3. Physical properties and hydrogeology (interpretation of physical properties related logging data, estimation of porosity and compaction/consolidation state, and estimation of hydrogeological properties);
4. Structural analysis (identification and characterization of fault zones, detailed fracture analysis using borehole images, borehole stability, and stress and strain analysis by identification of borehole breakouts); and
5. Log-seismic integration involving intensive processing of sonic and seismic-while-drilling data, as well as seismic modeling (synthetic seismogram), to improve time-depth relationships and reflector character and attributes.

In addition, specialty coordinators will visit the ship during the expedition and will assist the science party in coordinating data collection between the other susequent expeditions.

Sampling and data sharing strategy

NanTroSEIZE Stage 1 expeditions are a single coordinated science program

To maximize the science return, the three scheduled Stage 1 expeditions will be implemented as a single science program with samples and data shared across all three expeditions. This presents unique opportunities and challenges to ensure overall NanTroSEIZE project success, individual expedition success, and realization of each individual participant's scientific objectives.

We have not finalized all of the details, processes, and mechanisms for sample and data sharing, but members of the management structure (IODP-MI, SAS, NT-PMT, Co-Chief Scientists, CDEX, and USIO) are committed to working with the scientific participants to ensure effective and efficient implementation of the overall science plan.

Three key points related to overall research planning are as follows:

1. Specialty Coordinators. Unlike traditional stand-alone ODP-IODP legs and expeditions, unusual amounts of coordination and collaboration must occur among science parties across the three Stage 1 expeditions. Specialty Coordinators will be responsible for facilitating these essential collaborations. The NT-PMT has identified six specific research areas that require special effort over the project's duration. These include (a) lithostratigraphy and sedimentary petrology, (b) structural geology, (c) geotechnical properties and hydrogeology, (d) geochemistry, (e) core-log-seismic integration, and (f) paleomagnetism and biostratigraphy. Specialty Coordinators will provide technical and scientific guidance to each science party and facilitate cross-expedition collaborations among the science parties to achieve NanTroSEIZE Stage 1 objectives.
2. Community samples. As usual, individual scientists will collect samples for shipboard analyses and their postcruise research. In addition, however, we intend to collect substantial numbers of "community" archive samples, especially whole-round (WR) cores. In some cases, these community samples 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 over the duration of the NanTroSEIZE project.
3. Sample clusters. To ensure achievement of Stage 1 and overall NanTroSEIZE scientific objectives, it will be essential to co-locate suites of essential data types. This must be done with appropriate and consistent sample spacing throughout each site's stratigraphic succession and across all Stage 1 sites.

Research plan proposals (sample and data requests)

Shipboard and shore-based researchers should refer to the IODP Sample, Data, and Obligations Policy (**www.iodp.org/program-policies**). This document outlines the policy for distributing IODP samples and data and defines the obligations that sample and data recipients incur.

A coordinated Stage 1 research plan covering all samples and data is required well in advance of the first expedition that is scheduled to start in September 2007. Scientists must submit their research plans using the Sample/Data Request form available at **www.iodp.org/access-data**. This will be required much earlier for the NanTroSEIZE Stage 1 expeditions to ensure coordination among the four Stage 1 expeditions. The coordinated Stage 1 research plan will be developed prior to the first NanTroSEIZE Stage 1 expedition with substantial involvement and interaction of Stage 1 expedition Co-Chief Scientists, science participants, and Specialty Coordinators. We expect all of the individual expedition participants to honor expedition-specific as well as cross-expedition objectives and priorities. Substantial collaboration and cooperation will be required.

Access to data and core samples for specific research purposes, both during each expedition and during the subsequent 1 y moratorium, must be approved by the Sample Allocation Committee (SAC) for that particular expedition. The moratorium for NanTroSEIZE Stage 1 will extend 1 y from the completion of the last of the three scheduled Stage 1 expeditions, or if a significant postcruise sampling party is required, 1 y following the completion of the sampling party.

The SAC is composed of the Co-Chief Scientists, Staff Scientist, and IODP Curator on shore, and curatorial representatives in place of the curator on board ship. For NanTroSEIZE Stage 1, there is a SAC for each expedition. All three SACs will contribute to the overall coordinated research planning effort. The six Specialty Coordinators will also contribute to this process as project-wide representatives of their respective disciplines.

Based on research (sample and data) requests submitted, the SAC will work with the scientific party, other Stage 1 SACs, and Specialty Coordinators to formulate a formal expedition-specific data-sharing plan for shipboard and postcruise activities. This plan will be subject to modification depending upon the actual material/data recovered and collaborations that may evolve between scientists before and during the

Stage 1 expeditions. Modifications to the sampling plan during the expedition require the approval of the SAC.

All sample frequencies and sizes must be justified on a scientific basis and will depend on core recovery, the full spectrum of other requests, the expedition objectives, and project-wide NanTroSEIZE objectives. Success will require substantial amounts of cross-expedition collaboration, integration of complementary data sets, and consistent methods of analysis.

When critical intervals are recovered, there may be considerable demand for samples from a 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 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. The working plan will be based on the coordinated Stage 1 research plan to be developed prior to the first Stage 1 expedition. Following Expedition 316 and all NanTroSEIZE Stage 1 expeditions, cores will be delivered to the IODP Core Repository at Kochi University, Japan.

Cruise-specific sampling

The unique nature of the NanTroSEIZE project requires some adaptation of existing IODP policies and procedures. As scientists develop their individual research plans for core samples and data, they should refer to this expedition's scientific objectives (see above), the other three Stage 1 expeditions, as well as the overarching Stage 1 *Scientific Prospectus* (Tobin and Kinoshita, 2006b).

We anticipate an extensive sampling program to achieve research objectives within most disciplines. When possible, our goal will be to make as many measurements as possible on common (or nearly co-located) samples, thus reducing the amount of material removed from the core and maximizing our ability to correlate different data types. These sample clusters (e.g., pore water, carbon carbonate, moisture and density, bulk X-ray diffraction, clay X-ray diffraction, and bulk chemistry) will also improve our ability to complete routine complementary postcruise analyses. Substantial whole-round core sampling will be conducted to obtain appropriate samples for ephemeral shipboard analyses and to appropriately preserve samples for postcruise research. Such whole-round samples are especially important for geotechnical and rock mechanical tests (e.g., permeability, consolidation, triaxial, ring-shear, etc.). Because different laboratories employ different protocols and have different capabilities and limitations (e.g., elevated temperature, stress ranges, and strain rates), there are no rigorous standardized approaches for many of the critical measurements. This, combined with a need for comprehensive characterization of core materials over the broadest possible range of experimental conditions, requires a coordinated sampling approach. Experience further shows that it is impossible to identify all of the critical sampling intervals before the cores are split. Therefore, not only will whole-round samples be extracted for individual scientist's research, we will also to build a community archive. The community whole-round specimens will be stored at the repository (Kochi) and released to scientists only after they file appropriate sample requests. These samples will be used primarily to ensure that there are no critical gaps in sample characterization with respect to both spatial sample distribution and scientific data types generated, for interlaboratory calibration, redundancy, and quality assurance/ quality control (QA/QC).

Community labs for postexpedition analyses

Whereas many analyses can and will be conducted at sea, others require state-of-the-art instrumentation that is only available onshore. We are particularly concerned about stable isotopic measurements that depend upon dedicated instruments not found at all universities and government laboratories. For example, we expect to collect pore waters to measure at least Sr, B, Li, O, H, Cl, and C stable isotopic compositions. It is doubtful that any individual scientist has the onsite capability to make all of the measurements listed above. Issues regarding QA/QC become significant. To get the most consistent and reliable data for all Stage 1 expeditions, the NT-PMT has proposed that all samples for each category of geochemical analysis go to a single laboratory. Several laboratories (to be determined) will have to be involved. For example, one laboratory might measure O, H, and C isotopes, whereas another might measure Cl isotopes or Li. The choice of a particular laboratory (and analytical technique) will be reached by consensus of the inorganic geochemists who sail on the Stage 1 coring expeditions, mediated by the Specialty Coordinator in geochemistry and approved by the expedition SAC. We anticipate that data generated from each laboratory will be shared by all members of the Stage 1 scientific party for use as defined by the approved research plans.

References

Ashi, J., Kuramoto, S., Morita, S., Tsunogai, U., Goto, S., Kojima, S., Okamoto, T., Ishimura, T., Ijiri, A., Toki, T., Kudo, S., Asai, S., and Utsumi, M., 2002. Structure and cold seep of the Nankai accretionary prism off Kumano—outline of the off Kumano survey during YK01-04 Leg 2 cruise. *JAMSTEC J. Deep Sea Res.,* 20:1–8.

Austin, J.A., Jr., Christie-Blick, N., Malone, M.J., et al., 1998. *Proc. ODP, Init. Repts.,* 174A: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.174a.1998**

Becker, K., and Davis, E.E., 1998. *Advanced CORKs for the 21st Century:* report of a JOI/U.S. Science Support Program sponsored workshop [Online]. Available from World Wide Web: **http://www.usssp-iodp.org/Science_Support/Workshops/advanced_cork.html**.

Binns, R.A., Barriga, F.J.A.S., Miller, D.J., et al., 2002. *Proc. ODP, Init. Repts.,* 193: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.193.2002**

Bourlange, S., Jouniaux, L., and Henry, P., 2004. Data report: permeability, compressibility, and friction coefficient measurements under confining pressure and strain, Leg 190, Nankai Trough. *In* Mikada, H., Moore, G.F., Taira, A., Becker, K., Moore, J.C., and Klaus, A. (Eds.), *Proc. ODP, Sci. Results,* 190/196: College Station, Texas (Ocean Drilling Program), 1–16. **doi:10.2973/odp.proc.sr.190196.215.2004**

Byrne, D.E., Davis, D.M., and Sykes, L.R., 1988. Loci and maximum size of thrust earthquakes and the mechanics of the shallow region of subduction zones. *Tectonics,* 7:833–857.

Davis, E.E., and Becker, K., 1994. Formation temperatures and pressures in a sedimented rift hydrothermal system: ten months of CORK observations, Holes 857D and 858G. *In* Mottl, M.J., Davis, E.E., Fisher, A.T., and Slack, J.F. (Eds.), *Proc. ODP, Sci. Results,* 139: College Station, TX (Ocean Drilling Program), 649–666. **doi:10.2973/odp.proc.sr.139.255.1994**

Davis, E.E., Becker, K., Pettigrew, T., Carson, B., and MacDonald, R., 1992. CORK: a hydrologic seal and downhole observatory for deep-ocean boreholes. *In* Davis, E.E., Mottl, M.J., Fisher, A.T., et al., *Proc. ODP, Init. Repts.,* 139: College Station, TX (Ocean Drilling Program), 43–53. **doi:10.2973/odp.proc.ir.139.103.1992**

Davis, E.E., Becker, K., Wang, K., Obara, K., Ito, Y., and Kinoshita, M., 2006, A discrete episode of seismic and aseismic deformation of the Nankai Trough subduction zone accretionary prism and incoming Philippine Sea plate. *Earth Planet. Sci. Lett.,* 242(1–2):73–84. **doi:10.1016/j.epsl.2005.11.054**

Flemings, P.B., Behrmann, J.H., John, C.M., and the Expedition 308 Scientists, 2006. *Proc. IODP,* 308: College Station, TX (Integrated Ocean Drilling Program Management International, Inc.). **doi:10.2204/iodp.proc.308.2006**

Hyndman, R.D., Yamano, M., and Oleskevich, D.A., 1997. The seismogenic zone of subduction thrust faults. *Isl. Arc,* 6(3):244–260. **doi:10.1111/j.1440-1738.1997.tb00175.x**

Ito, Y., and Obara, K., 2006. Very low frequency earthquakes within accretionary prisms are very low stress-drop earthquakes. *Geophys. Res. Lett.,* 33(9):L09302. **doi:10.1029/2006GL025883**

Kelemen, P.B., Kikawa, E., Miller, D.J., et al., 2004. *Proc. ODP, Init. Repts.,* 209: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.209.2004**

Kimura, G., Silver, E.A., Blum, P., et al., 1997. *Proc. ODP, Init. Repts.,* 170: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.170.1997**

Kinoshita, M., Goto, S., Hamamato, H., and Yamano, M., 2003. Heat flow distribution and thermal regime across the Nankai accretionary complex. *Eos, Trans. Am. Geophys. Union*, 84(46) (Suppl.):T42C-06 (Abstract).

Kinoshita, M., Moore, G., von Huene, R., Tobin, H., and Ranero, C.R., 2006. The Seismic Zone Experiment. *Oceanography*, 19(4):28–38.

Kodaira, S., Takahashi, N., Park, J., Mochizuki, K., Shinohara, M., and Kimura, S., 2000. Western Nankai Trough seismogenic zone: results from a wide-angle ocean bottom seismic survey. *J. Geophys. Res.*, 105:5887–5905.

Le Pichon, X., Iiyama, T., Chamley, H., Charvet, J., Faure, M., Fujimoto, H., Furuta, T., Ida, Y., Kagami, H., Lallemant, S., Leggett, J., Murata, A., Okada, H., Rangin, C., Renard, V., Taira, A., and Tokuyama, H., 1987a. Nankai Trough and fossil Shikoku Ridge: results of Box 6 Kaiko Survey. *Earth Planet. Sci. Lett.*, 83:186–198. **doi:10.1016/0012-821X(87)90065-3**

Le Pichon, X., Iiyama, T., Chamley, H., Charvet, J., Faure, M., Fujimoto, H., Furuta, T., Ida, Y., Kagami, H., Lallemant, S., Leggett, J., Murata, A., Okada, H., Rangin, C., Renard, V., Taira, A., and Tokuyama, H., 1987b. The eastern and western ends of Nankai Trough: results of Box 5 and Box 7 Kaiko survey. *Earth Planet. Sci. Lett.*, 83:199–213. **doi:10.1016/0012-821X(87)90066-5**

Mazzotti, S., LePichon, X., Henry, P., and Miyazaki, S., 2000. Full interseismic locking of the Nankai and Japan-West Kuril Subduction Zones: an analysis of uniform elastic strain accumulation in Japan constrained by permanent GPS. *J. Geophys. Res.*, 105:13159–13177.

McNeill, L.C., Ienaga, M., Tobin, H., Saito, S., Goldberg, D., Moore, J.C., and Mikada, H., 2004. Deformation and in situ stress in the Nankai accretionary prism from resistivity-at-bit images, ODP Leg 196. *Geophys. Res. Lett.*, 31(2):L02602. **doi:10.1029/2003GL018799**

Mikada, H., Becker, K., Moore, J.C., Klaus, A., et al., 2002. *Proc. ODP, Init. Repts.*, 196: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.196.2002**

Moore, G.F., Mikada, H., Moore, J.C., Becker, K., and Taira, A. 2005. Legs 190 and 196 synthesis: deformation and fluid flow processes in the Nankai Trough accretionary prism. *In* Mikada, H., Moore, G.F., Taira, A., Becker, K., Moore, J.C., and Klaus, A. (Eds.), *Proc. ODP, Sci. Results,* 190/196: College Station, TX (Ocean Drilling Program), 1–25. **doi:10.2973/odp.proc.sr.190196.201.2005**

Moore, G.F., Taira, A., Klaus, A., Becker, L., Boeckel, B., Cragg, B.A., Dean, A., Fergusson, C.L., Henry, P., Hirano, S., Hisamitsu, T., Hunze, S., Kastner, M., Maltman, A.J., Morgan, J.K., Murakami, Y., Saffer, D.M., Sánchez-Gómez, M., Screaton, E.J., Smith, D.C., Spivack, A.J., Steurer, J., Tobin, H.J., Ujiie, K., Underwood, M.B., and Wilson, M., 2001. New insights into deformation and fluid flow processes in the Nankai Trough accretionary prism: results of Ocean Drilling Program Leg 190. *Geochem., Geophys., Geosyst.,* 2(10). **doi:10.1029/2001GC000166**

Moore, J.C., Klaus, A., et al., 1998. *Proc. ODP, Init. Repts.,* 171A: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.171a.1998**

Moore, J.C., and Saffer, D., 2001. Updip limit of the seismogenic zone beneath the accretionary prism of southwest Japan: an effect of diagenetic to low-grade metamorphic processes and increasing effective stress. *Geology,* 29(2):183–196. **doi:10.1130/0091-7613(2001)029<0183:ULOTSZ>2.0.CO;2**

Nakanishi, A., Takahashi, N., Park, J.-O., Miura, S., Kodaira, S., Kaneda, Y., Hirata, N., Iwasaki, T., and Nakamura, M., 2002. Crustal structure across the coseismic rupture zone of the 1944 Tonankai earthquake, the central Nankai Trough seismogenic zone. *J. Geophys. Res.,* 107(B1):2007. **doi:10.1029/2001JB000424**

Nakanishi, A., Kodaira, S., Miura, S., Ito, A., Sato, T., Park, J.-O., Kido, Y., and Kaneda, Y., submitted. Detailed structural image around splay fault branching in the Nankai subduction zone: results from a high-density ocean-bottom seismic survey. *J. Geophys. Res.*

Obana, K., Kodaira, S., Mochizuki, K., and Shinohara, M., 2001. Micro-seismicity around the seaward updip limit of 1946 Nankai earthquake dislocation area. *Geophys. Res. Lett.,* 28(12):2333–2336. **doi:10.1029/2000GL012794**

Obara, K., and Ito, Y., 2005. Very low frequency earthquakes excited by the 2004 off the Kii Peninsula earthquakes: a dynamic deformation process in the large accretionary prism. *Earth, Planets Space,* 57(4):321–326.

O'Brien, P.E., Cooper, A.K., Richter, C., et al., 2001. *Proc. ODP, Init. Repts.,* 188: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.188.2001**

Okino, K., Shimakawa, Y., and Nagaoka, S., 1994. Evolution of the Shikoku Basin. *J. Geomagn. Geoelectr.,* 46:463–479.

Park, J.-O., Tsuru, T., Kodaira, S., Cummins, P.R., and Kaneda, Y., 2002. Splay fault branching along the Nankai subduction zone. *Science,* 297(5584):1157–1160. **doi:10.1126/science.1074111**

Park, J.-O., Tsuru, T., No, T., Takizawa, T., Sato, S., and Kaneda, Y., 2006. High-resolution 3-D seismic reflection study in the Nankai subduction zone off Kii Peninsula, southwest Japan. *Eos, Trans. Am. Geophys. Union,* 87(52), Fall Meeting Suppl., Abstract T21A-0385.

Riedel, M., Collett, T.S., Malone, M.J., and the Expedition 311 Scientists, 2006. *Proc. IODP,* 311: Washington, DC (Integrated Ocean Drilling Program Management International, Inc.). **doi:10.2204/iodp.proc.311.2006**

Ruff, L., and Kanamori, H., 1983. Seismic coupling and uncoupling at subduction zones. *Tectonophysics,* 99(2–4):99–117. **doi:10.1016/0040-1951(83)90097-5**

Saffer, D.M., and Marone, C., 2003. Comparison of smectite- and illite-rich gouge frictional properties: application to the up-dip limit of the seismogenic zone along subduction megathrusts. *Earth Planet. Sci. Lett.,* 215(1–2):219–235. **doi:10.1016/S0012-821X(03)00424-2**

Screaton, E., Saffer, D., Henry, P., and Hunze, S., 2002. Porosity loss within the underthrust sediments of the Nankai accretionary complex: implications for overpressures. *Geology,* 30(1):19–22. **doi:10.1130/0091-7613(2002)030<0019:PLWTUS>2.0.CO;2**

Seno, T., Stein, S., and Gripp, A.E., 1993. A model for the motion of the Philippine Sea plate consistent with NUVEL-1 and geological data. *J. Geophys. Res.,* 98:17941–17948.

Shipboard Scientific Party, 2002a. Explanatory notes. *In* Mikada, H., Becker, K., Moore, J.C., Klaus, A., et al., *Proc. ODP, Init. Repts.,* 196: College Station, TX (Ocean Drilling Program), 1–53. **doi:10.2973/odp.proc.ir.196.102.2002**

Shipboard Scientific Party, 2002b. Leg 196 summary: deformation and fluid flow processes in the Nankai Trough accretionary prism: logging while drilling and Advanced CORKs. *In* Mikada, H., Becker, K., Moore, J.C., Klaus, A., et al., *Proc. ODP, Init. Repts.,* 196: College Station TX (Ocean Drilling Program), 1–29. **doi:10.2973/odp.proc.ir.196.101.2002**

Shipley, T.H., Ogawa, Y., Blum, P., et al., 1995. *Proc. ODP, Init. Repts.,* 156: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.156.1995**

Tobin, H., and Kinoshita, M., 2006a. NanTroSEIZE: the IODP Nankai Trough seismogenic zone experiment. *Sci. Drill.,* 2:23–27. **doi:10.2204/iodp.sd.2.06.2006**

Tobin, H.J., and Kinoshita, M., 2006b. Investigations of seismogenesis at the Nankai Trough, Japan. *IODP Sci. Prosp.,* NanTroSEIZE Stage 1. **doi:10.2204/iodp.sp.nantroseize1.2006**

Tréhu, A.M., Bohrmann, G., Rack, F.R., Torres, M.E., et al., 2003. *Proc. ODP, Init. Repts.,* 204: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.204.2003**

Wang, K., and Hu, Y., 2006. Accretionary prisms in subduction earthquake cycles: the theory of dynamic Coulomb wedge. *J. Geophys. Res.,* 111(B6):B06410. **doi:10.1029/2005JB004094**

Wu, H.-Y., Ma, K.-F., Zoback, M., Boness, N., Ito, H., Hung, J.-H., and Hickman, S., 2007. Stress orientations of Taiwan Chelungpu-Fault Drilling Project (TCDP) hole-A as observed from geophysical logs. *Geophys. Res. Lett.,* 34:L01303. **doi:10.1029/2006GL028050**

Table T1. Operation plan and time estimate for Expedition 314.

Proposed site	Location		Depth (mbsf)	Operations description	Days	
	Latitude	Longitude			Transit	LWD
Shingu port				Science party boards ship	2.0 (in port)	
NT2-03B, NT1-03A				Start of Expedition 314 with pilot hole drilling	0.4	7.1
NT1-01A	32°44.8878′N	136°55.0236′E	3610	Transit ~18 nmi to proposed Site NT1-01A at 6 kt Hole A: LWD/MWD to 600 mbsf	0.13	3.4
NT2-03B	33°14.300′N	136°42.650′E	2178	Transit ~32 nmi to proposed Site NT2-03B at 6 kt Hole A: LWD/MWD to 1000 mbsf	0.22	3.28
NT3-01B	33°18.020′N	136°38.180′E	1966	Transit ~6 nmi to proposed Site NT3-01B at 6 kt Hole A: LWD/MWD to 1400 mbsf with 9-5/8 inch casing ~1000 m	0.04	14.46
NT2-01B	33°13.320′N	136°42.200′E	2391	Transit ~6 nmi to proposed Site NT2-01B at 6 kt Hole A: LWD/MWD to 1000 mbsf	0.04	3.46
NT1-03B	33°01.635′N	136°47.639′E	3832	Transit ~13 nmi to proposed Site NT1-03B at 6 kt Hole A: LWD/MWD to 950 mbsf	0.10	3.4
NT1-07A	32°49.730′N	136°52.890′E	4062	Transit ~13 nmi to proposed Site NT1-07A at 6 kt Hole A: LWD/MWD to 1200 mbsf	0.10	4.9
Ugata, Shima				Helicopter transfer to Ugata, Shima in Mie Prefecture End of Expedition 314		
				Contingency:	15	
				Total operating days:	57	

Note: LWD = logging while drilling, MWD = measurement while drilling.

Figure F1. Map of Kumano Basin region with planned Stage 1 drill sites. Red dots = proposed primary sites, green dots = proposed alternate sites, black outline = location of 2006 three-dimensional seismic survey, thick black line = KR0108-5 two-dimensional seismic surveys.

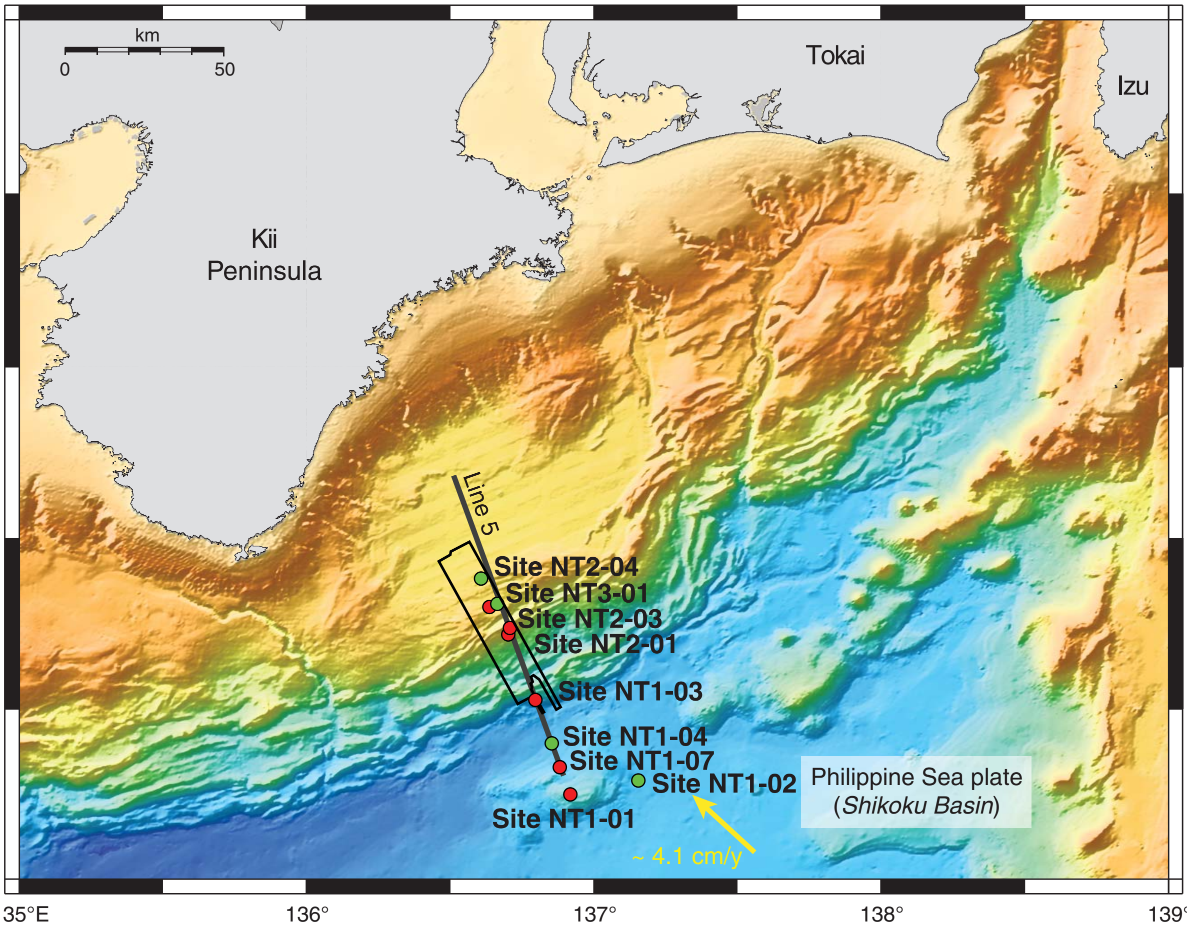


Figure F2. Interpretation of seismic Line KR0108-5 (Park et al., 2002) showing locations of Stage 1 sites proposed for logging while drilling, coring, and downhole measurement, after Tobin and Kinoshita (2006a). Solid rectangles = proposed drilling depths for Stage 1, empty rectangles = proposed depths for future operations. Blue = Stage 1, orange = Stage 2, red = Stage 3.

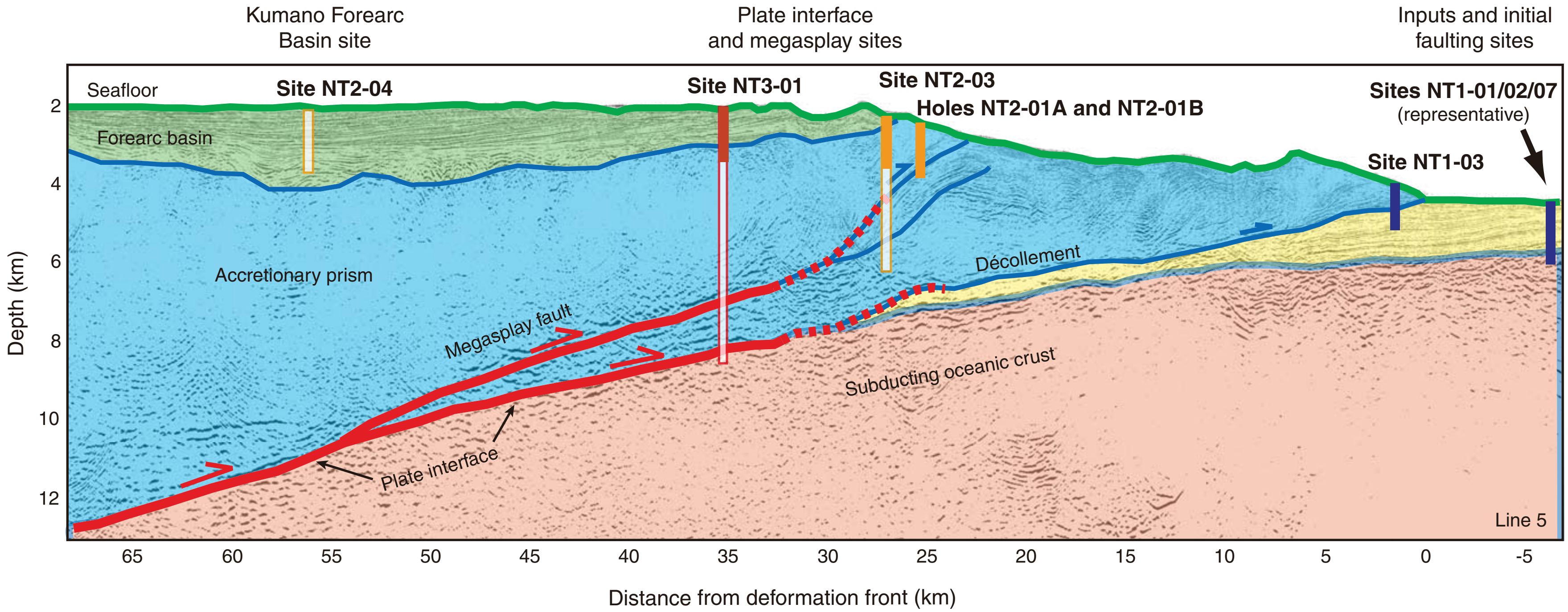


Figure F3. Seismic Profile ODKM-100 along the Nankai Trough axis. Multichannel seismic data was obtained by CDEX and the interpretation is by T. Ike (pers. comm., 2005). USB = upper Shikoku Basin, LSB = lower Shikoku Basin, LSB-T= lower Shikoku Basin turbidites.

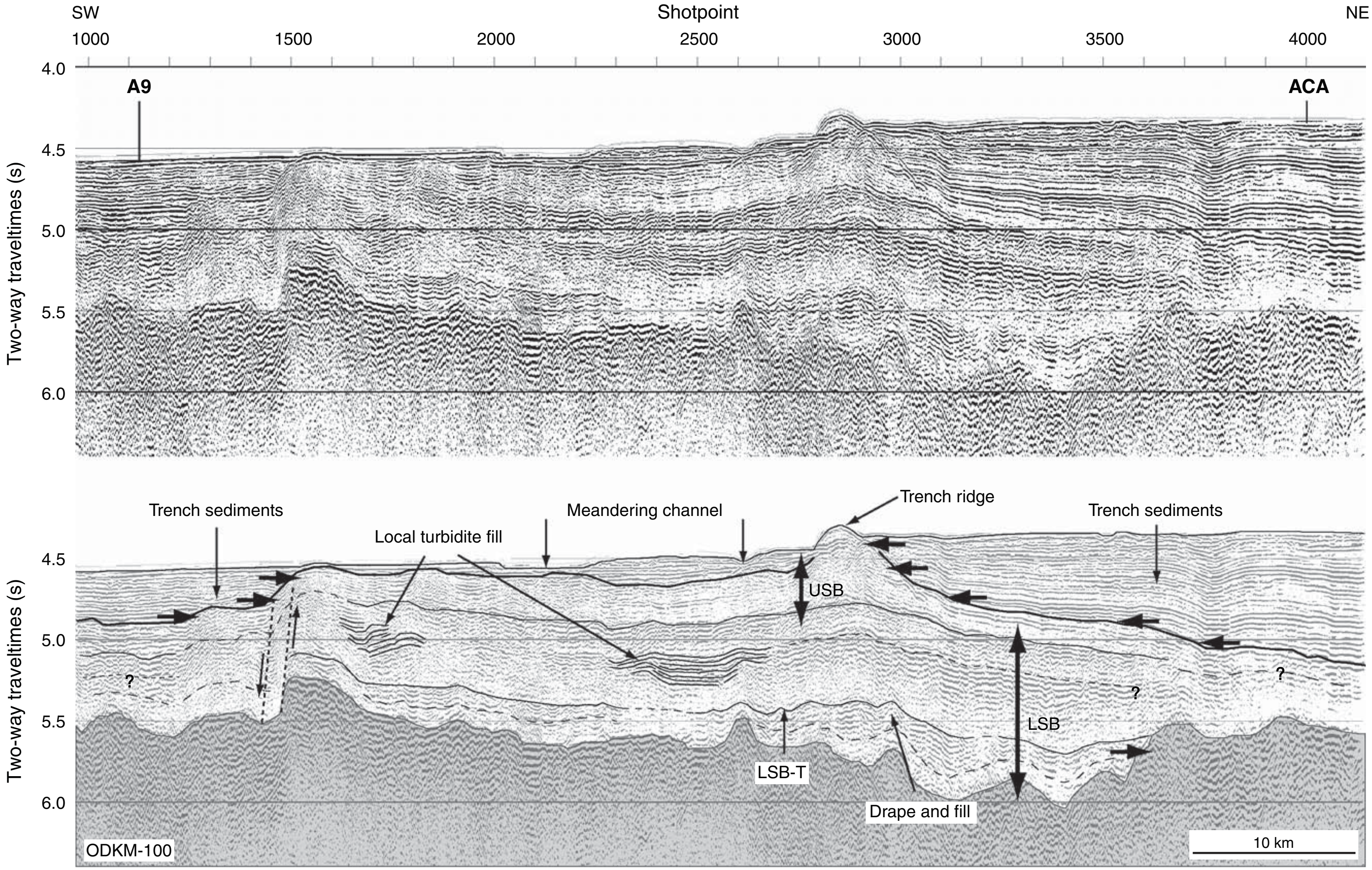


Figure F4. Interpreted three-dimensional seismic Profile IL2645 across the Kumano forearc basin showing four major unconformities (colored lines).

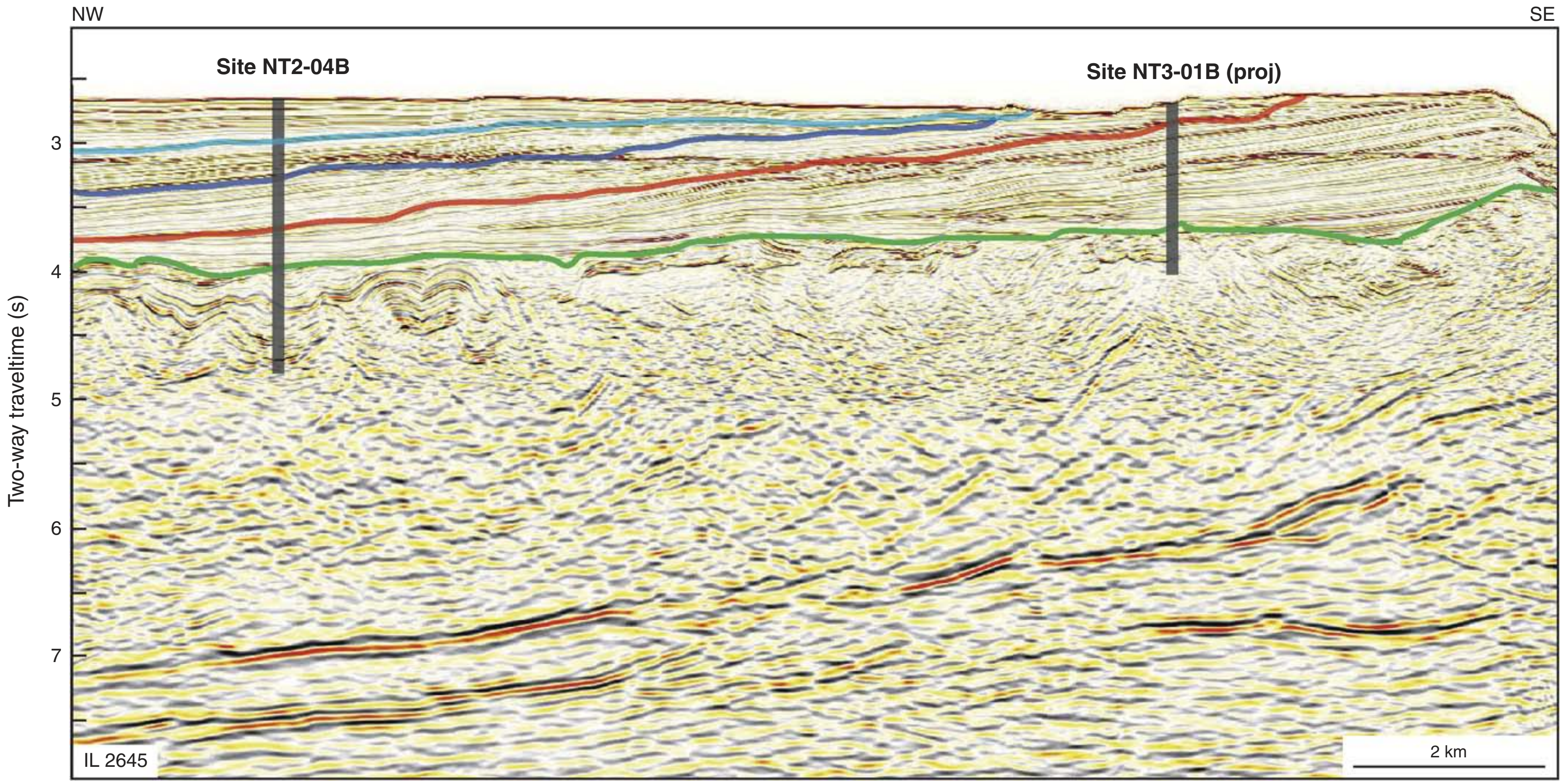


Figure F5. Heat flow distribution in the Nankai Trough off Kumano without estimates from bottom-simulating reflector. Note that some heat flow data are unpublished and preliminary.

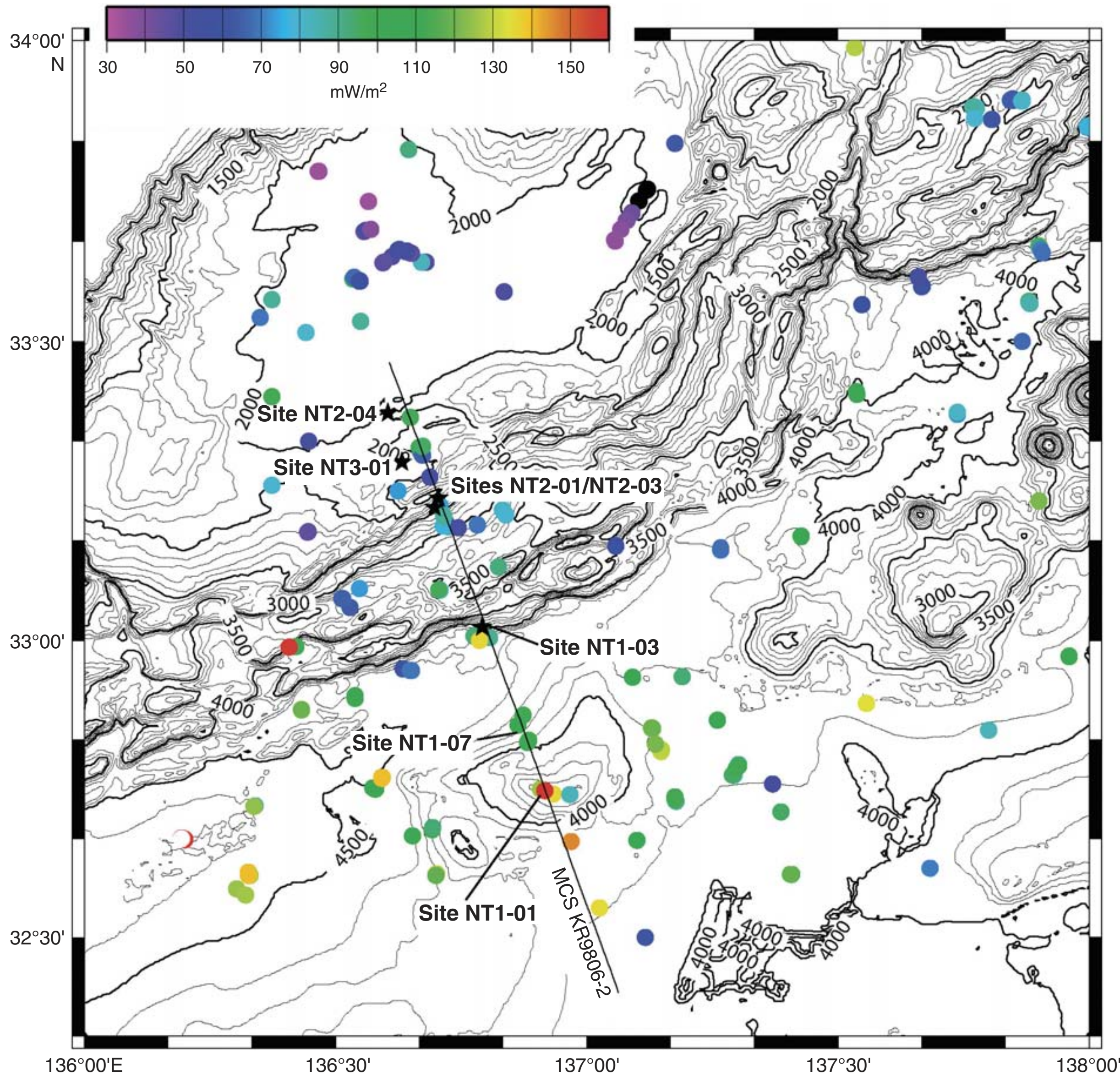


Figure F6. A. Three-dimensional (3-D) view of the resistivity-at-the-bit image of part of the frontal thrust zone shown in its cylindrical borehole form. The image shows steeply south dipping conductive fractures (picked out by blue circles) within a highly resistive deformation zone (Shipboard Scientific Party, 2002c). (Continued on next page.)

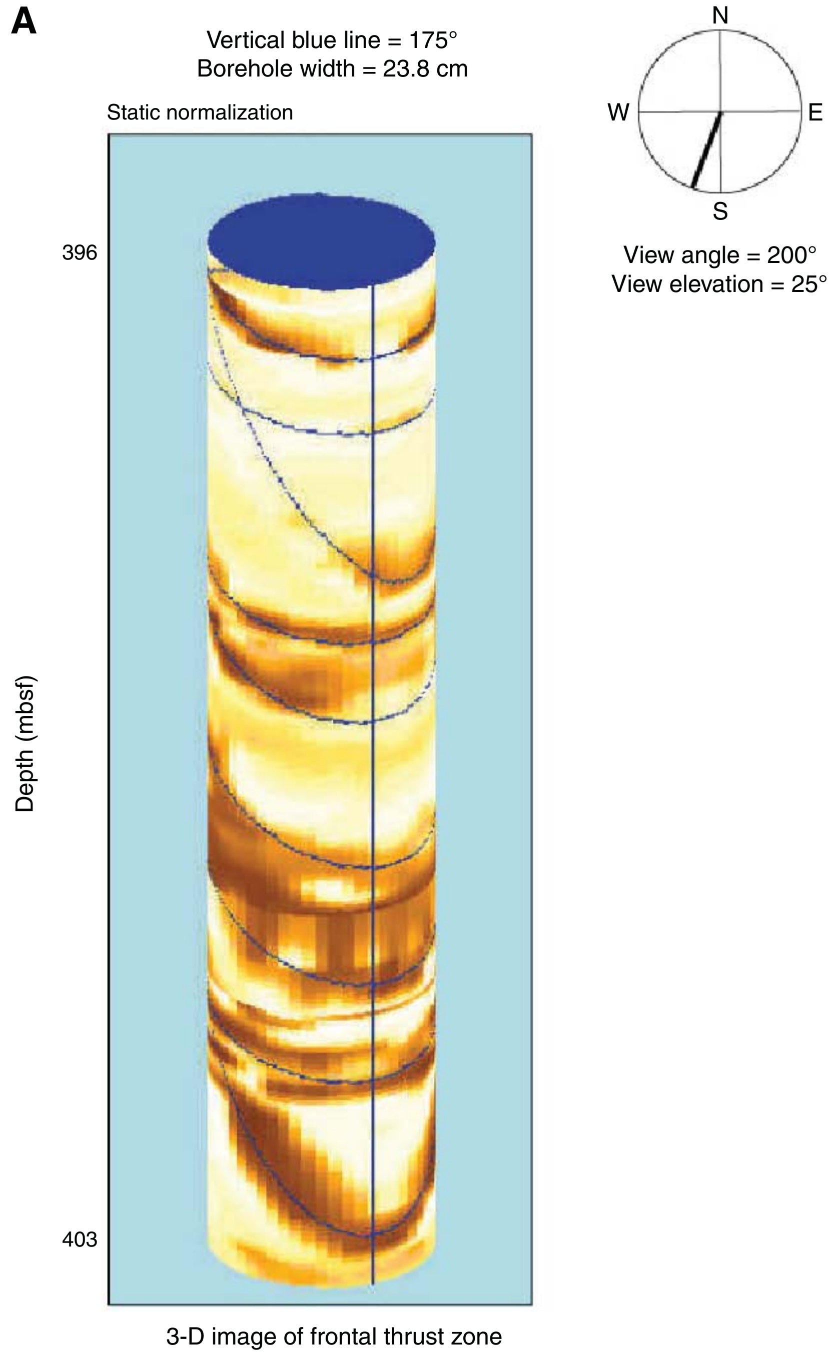


Figure F6 (continued). B. Resistivity-at-the-bit image from ODP Hole 808I, showing all interpreted fractures. Fractures are separated into conductive (blue) and resistive (red) fractures. Fracture orientations inferred from borehole breakout are dominantly northeast–southwest (dip directions northwest–southeast) within the fontal thrust zone and 560-mbsf fractured interval (Shipboard Scientific Party, 2002c).

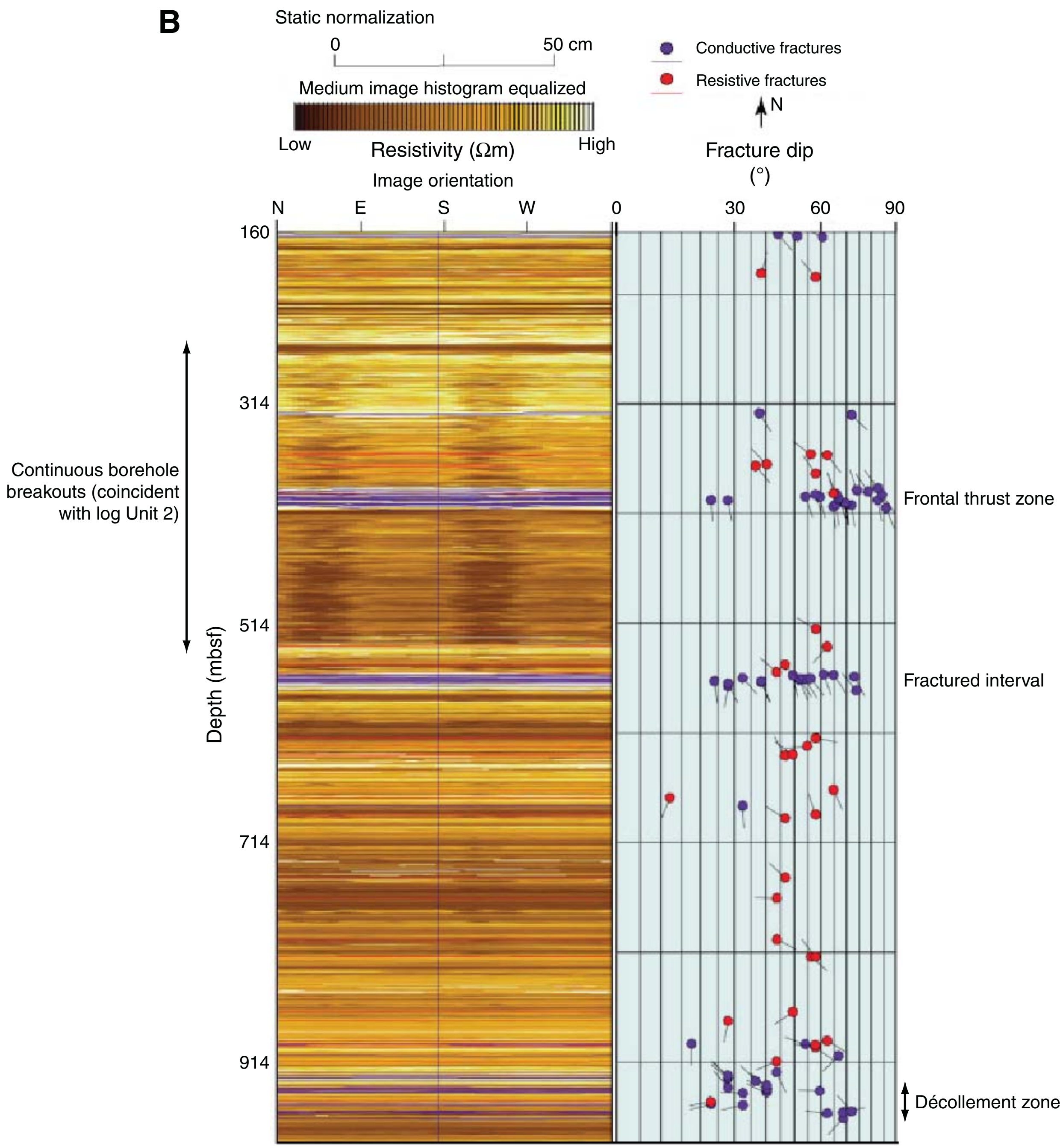


Figure F7. Location of proposed Site NT1-01A together with Shikoku Basin reference sites along the IFREE three-dimensional (3-D) seismic Inline 95. Proposed primary (Sites NT1-01A, NT1-07A, and NT1-03B) and alternate (Sites NT1-04C, NT1-03A, and NT1-03C) Stage 1 drill sites distributed along a transect from the prism toe (proposed Site NT1-03A) to the subducting basement high (proposed Site NT1-01A) are shown overlain on IFREE 3-D seismic reflection Line 95.

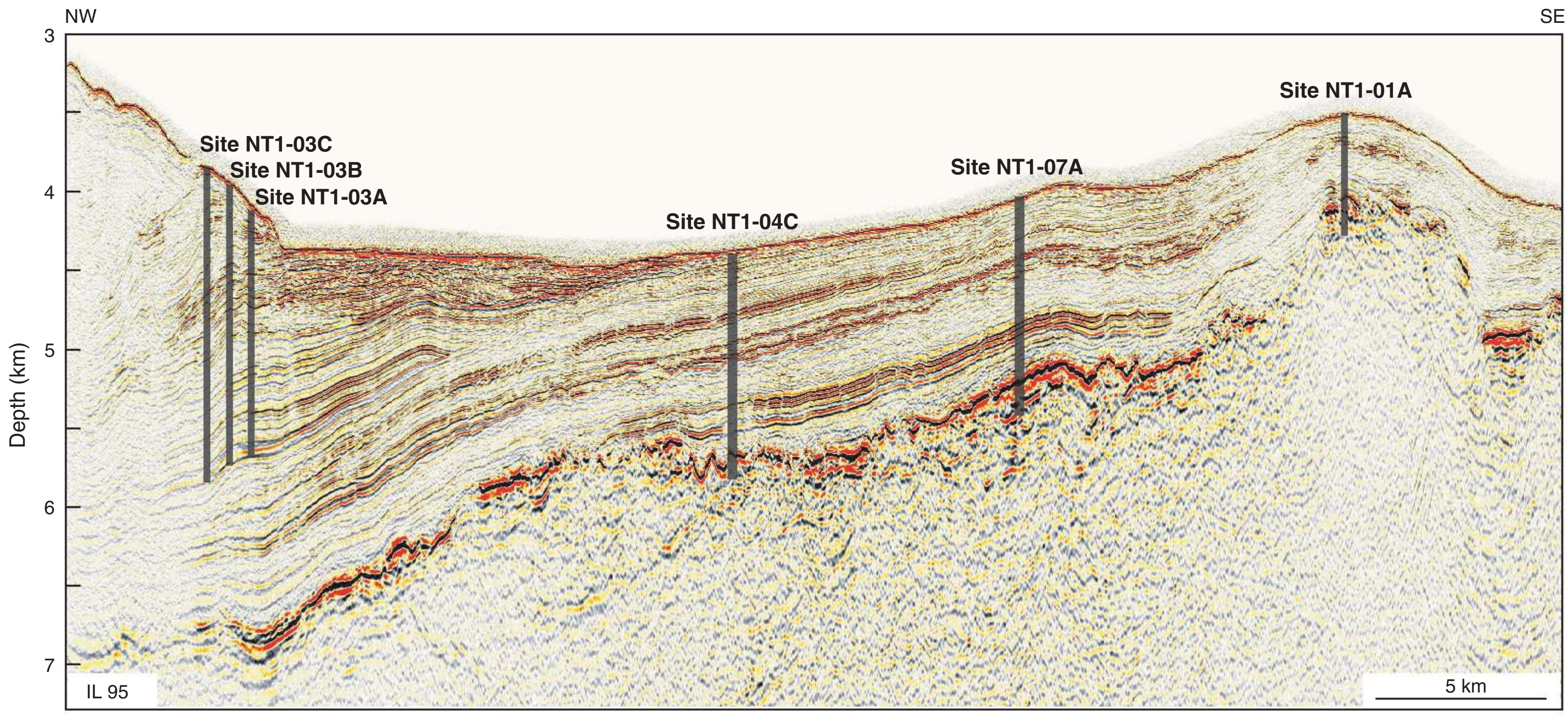


Figure F8. IFREE three-dimensional seismic reflection Line 95 showing location of proposed Site NT1-07A.

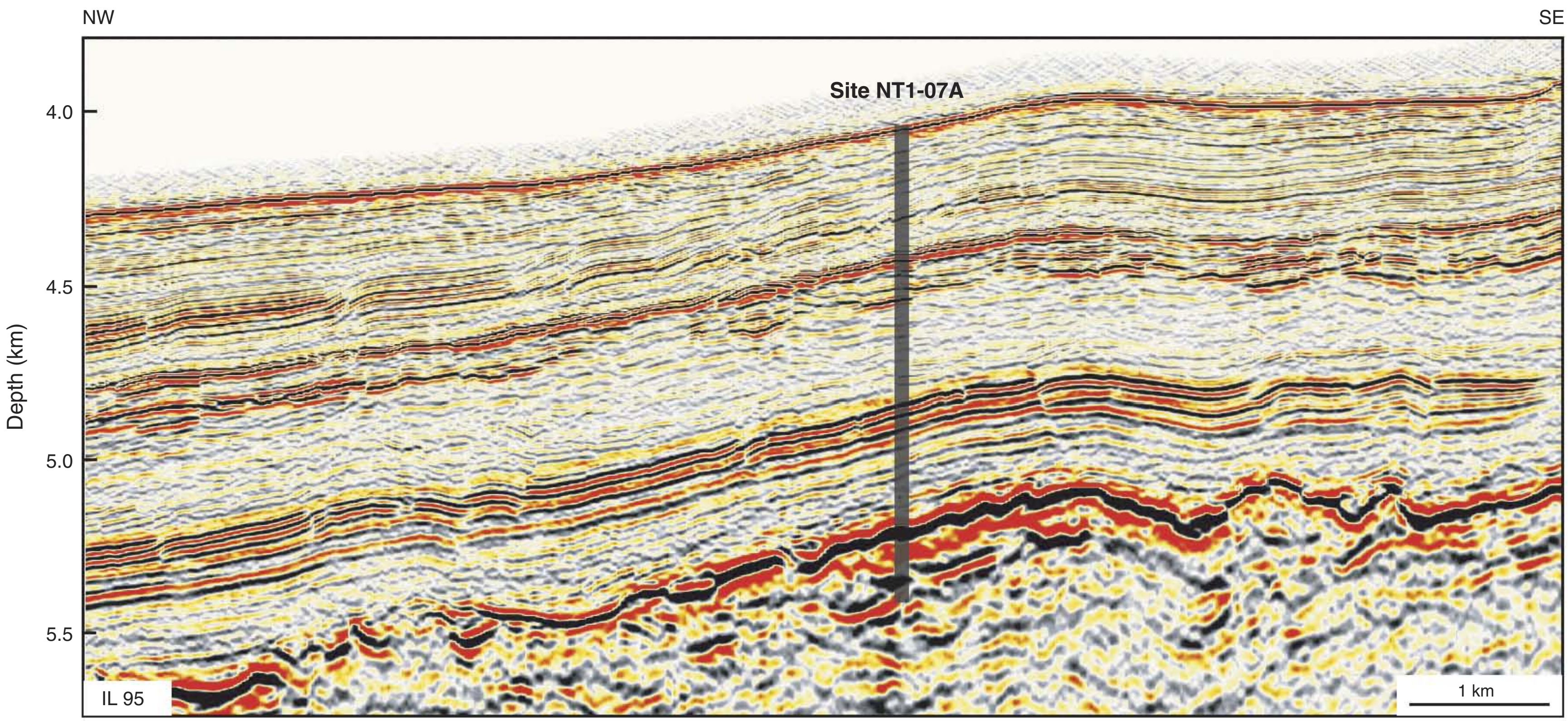


Figure F9. Proposed Site NT1-03, with three options (A, B, and C), showing small variations along the CDEX and IFREE three-dimensional seismic inlines.

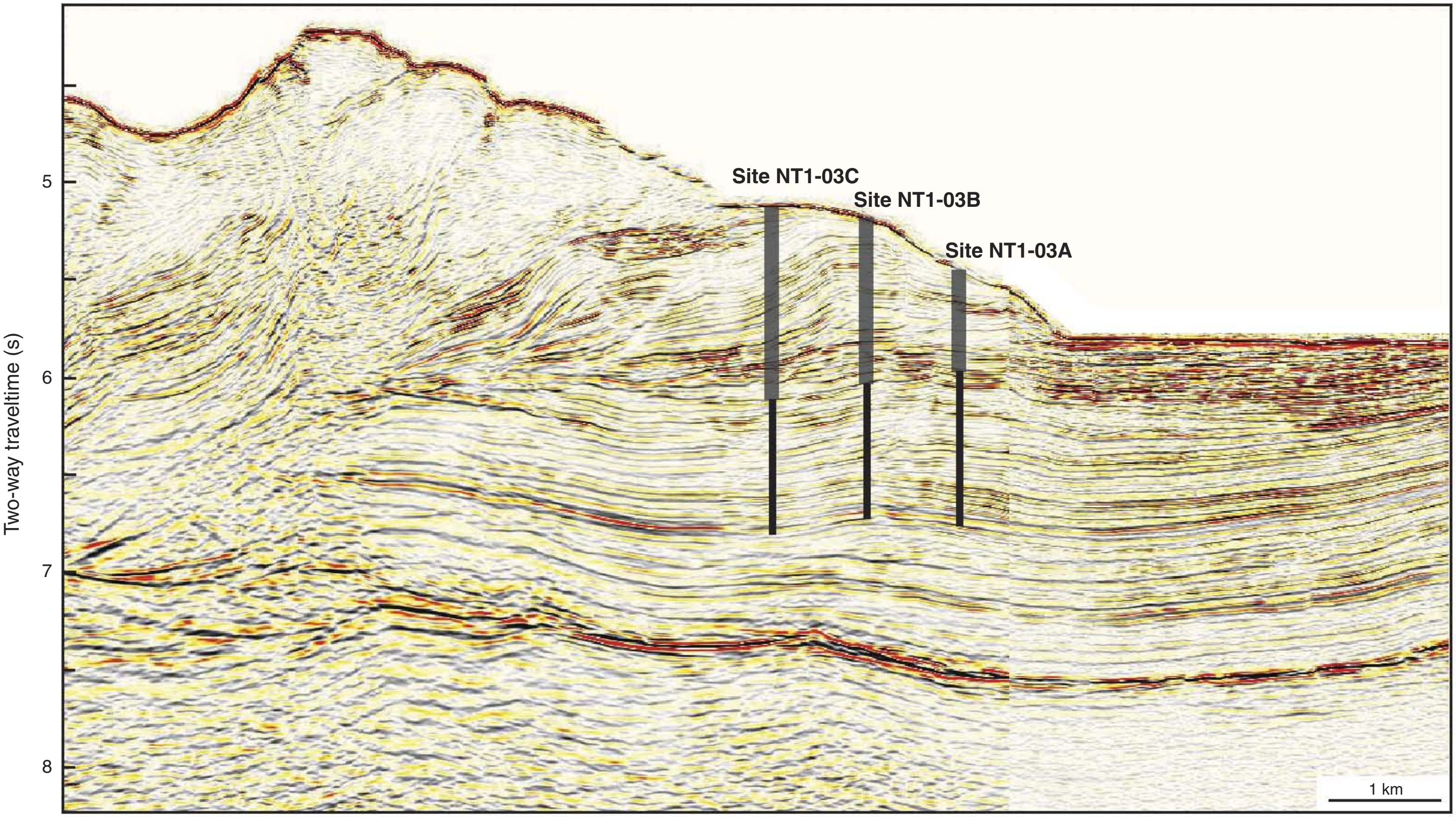


Figure F10. Detail of three-dimensional seismic Inline 2596 showing location of proposed Sites NT2-01B and NT2-03C.

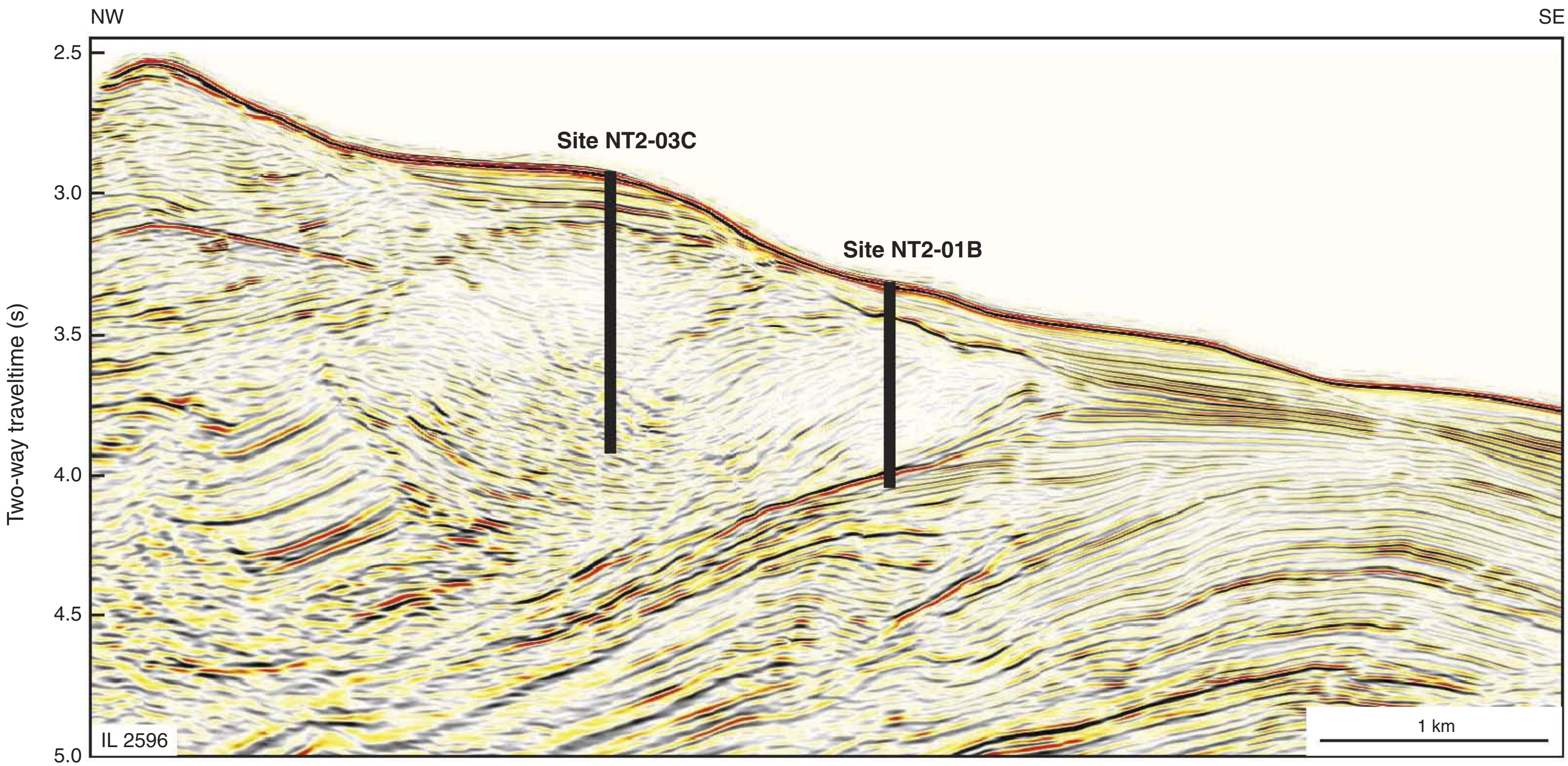


Figure F11. Three-dimensional seismic Inline 2529 showing regional setting of proposed Site NT3-01B.

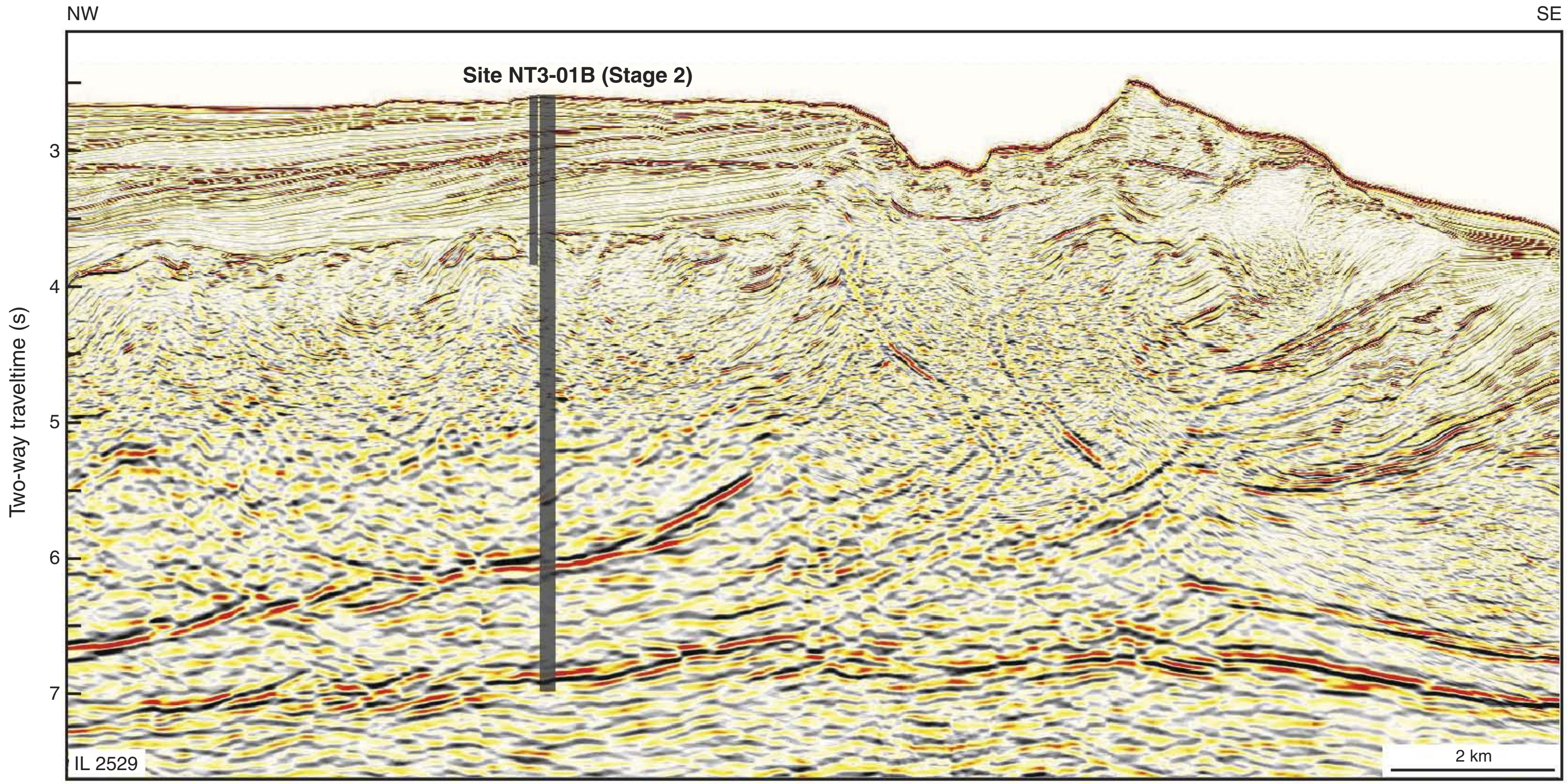


Figure F12. Closeup view of proposed Site NT3-01B shown on three-dimensional seismic Inline 2529.

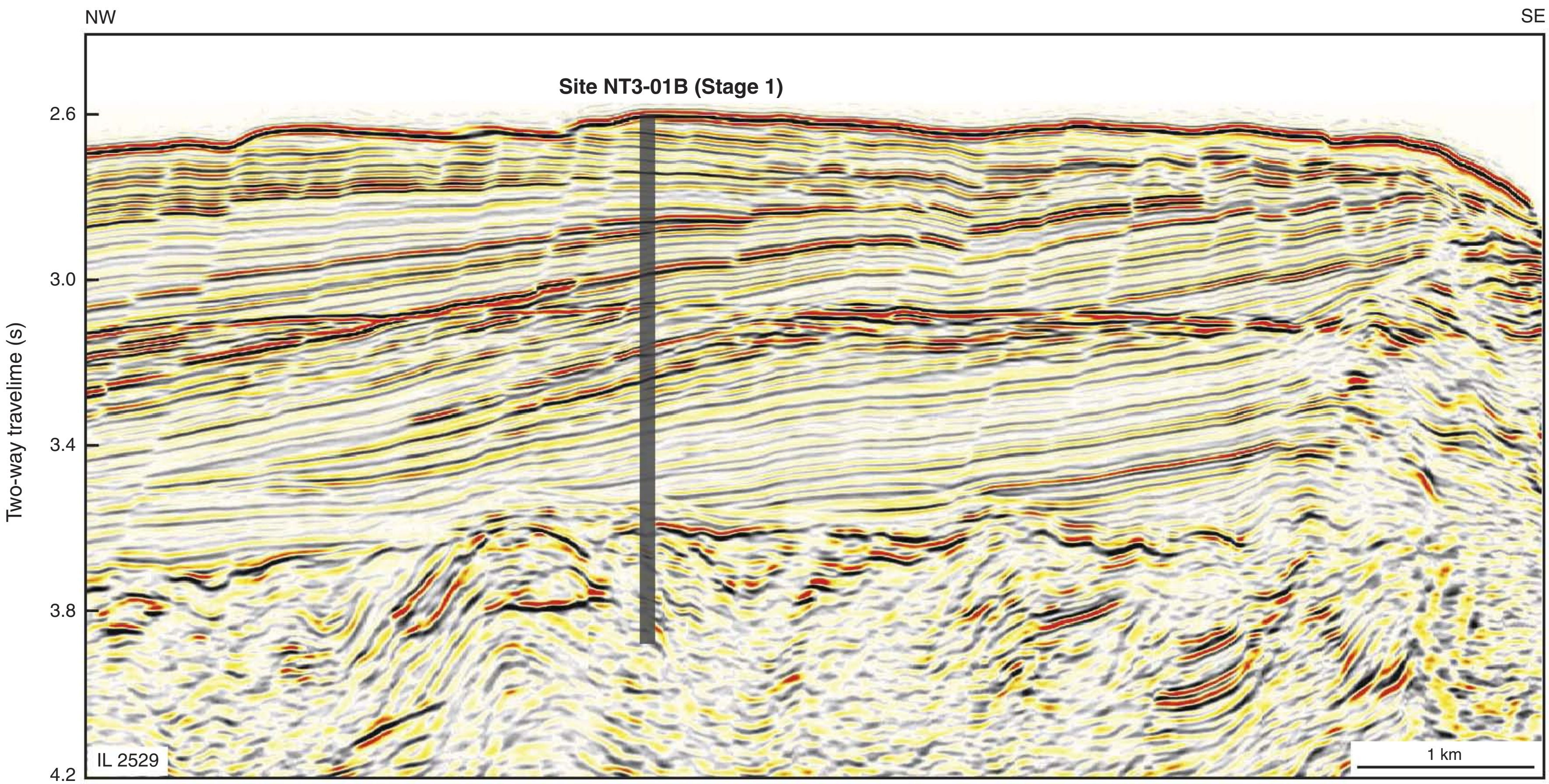


Figure F13. Detail of three-dimensional seismic Inline 2645 showing location of Site NT2-04B.

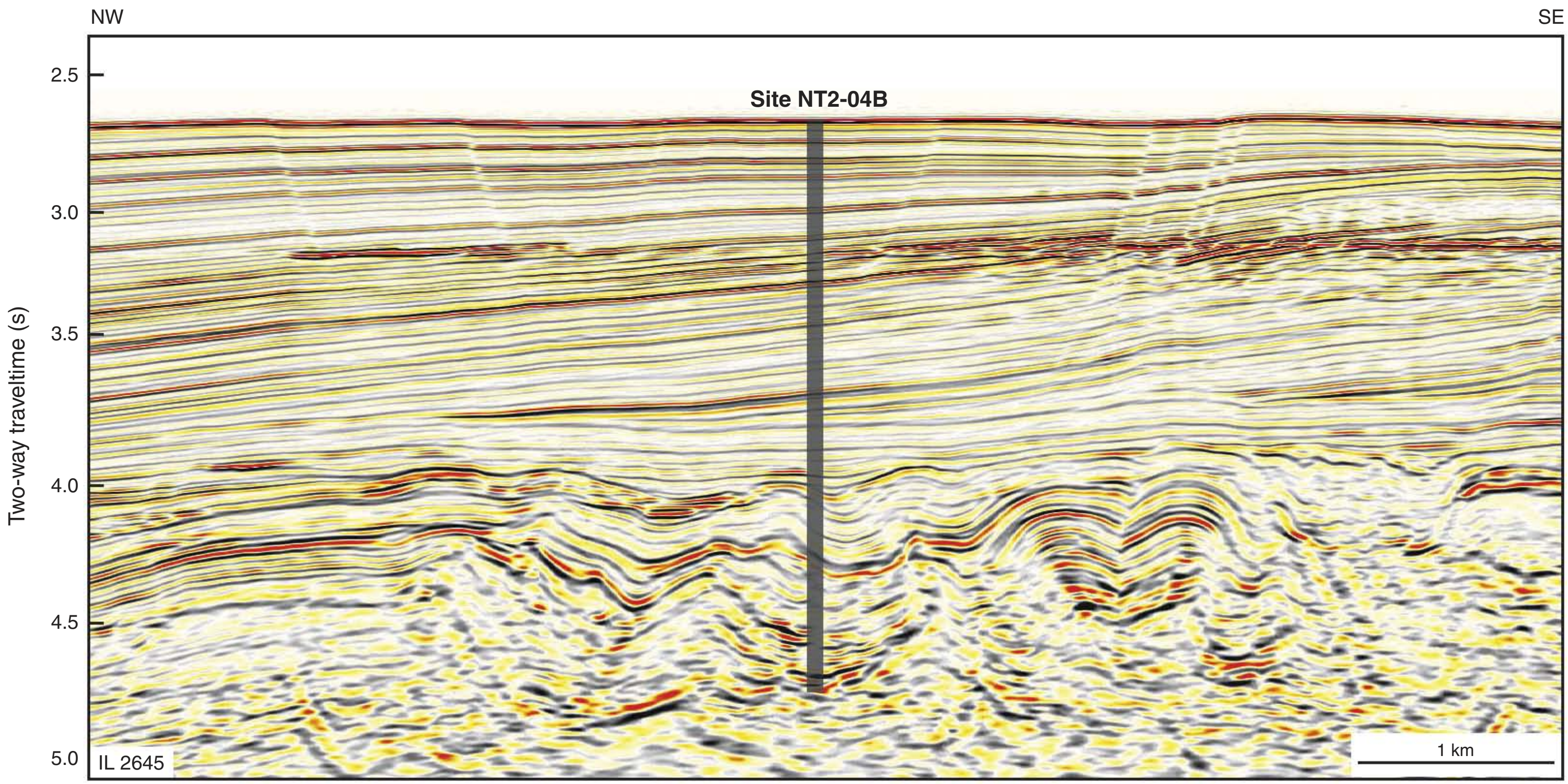
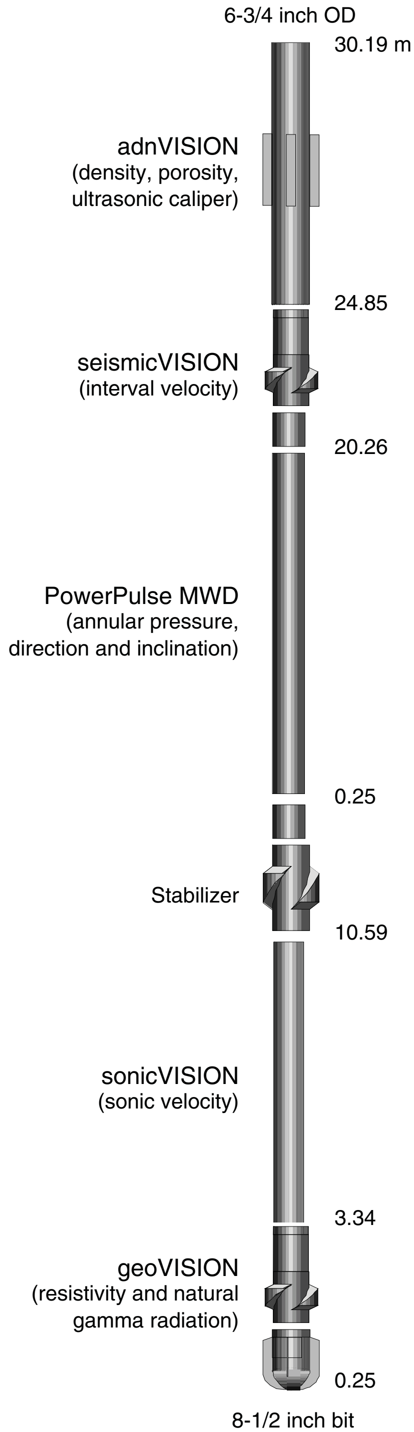


Figure F14. Logging-while-drilling tool string showing each measurement tool and distance from the bit at the bottom. OD = outer diameter, MWD = measurement while drilling.



Site summaries

Proposed Site NT1-01A

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) Alternate: • Other Stage 1 expeditions
Position:	32°44.8878′N, 136°55.0236′E
Water Depth (m):	3610
Target drilling depth (mbsf):	600 m sediment (Stage 1)
Approved maximum penetration (mbsf):	800; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	Extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track maps (Figs. **AF1, AF4**) • Line odkm 03-AB SP 2795 (Fig. **AF2**) • CrossLine odkm 03-22 SP 1685 (Fig. **AF3**) • IFREE 3-D Inline 95 (Fig. **AF5, AF6**)
Objective (see text for full details):	Reference site: • Penetrate entire sedimentary section and into oceanic crust • Document lithologic, hydrologic, thermal, and geotechnical properties of subduction inputs • Log-seismic integration
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314: Hole A: MWD/LWD
Anticipated lithology:	0–600 mbsf: Shikoku Basin hemipelagic sediments 600–800 mbsf: volcaniclastic sediments and basalt

Site summaries (continued)

Proposed Site NT1-02A

Priority:	Alternate to proposed Site NT1-07A
Position:	32°47.4996′N, 137°9.2784′E
Water depth (m):	4210
Target drilling depth (mbsf):	830 (730 m sediment + 100 m basement)
Approved maximum penetration (mbsf):	720; EPSP, December 2005; permission to penetrate to 930 mbsf being requested of EPSP
Survey coverage:	Extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF7**) • Lines odkm 03-22 (Fig. **AF8**) and odkm 03-103-1 (Fig. **AF9**) • CrossLine KR9806-1 (Fig. **AF10**)
Objective (see text for full details):	Core and conduct downhole measurements throughout the entire Shikoku Basin section and uppermost portion of the underlying oceanic crust
Drilling, coring, and downhole measurement program:	See **NT1-07A**
Anticipated lithology:	0–730 mbsf: Shikoku Basin hemipelagic sediments and turbidites 730 mbsf: volcaniclastic sediments and basalt

Site summaries (continued)

Proposed Site NT1-03A

Priority:	Alternate for proposed Site NT1-03B
Position:	33°01.23258′N, 136°47.94852′E
Water depth (m):	3955
Target drilling depth (mbsf):	600 sediment (Stage 1)
Approved maximum penetration (mbsf):	1800; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	Extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track maps (Figs. **AF11, AF4**) • Lines odkm 03-K SP 2435 (Fig. **AF12**) and 95 (Fig. **AF5**) • CrossLine KR9806-12 (Fig. **AF13**) • IFREE 3-D Inline (Fig. **AF14**)
Objective (see text for full details):	Characterize incoming sedimentary sequence (lithologic, hydrologic, thermal, geotechnical, geochemical properties) Document early phases of deformation Verify location of frontal décollement Although penetration to basement is desirable, a more important goal is to sample as much of the lower Shikoku Basin as possible.
Drilling, coring, and downhole measurement program:	See **NT1-03B**
Anticipated lithology:	0–20 mbsf: hemipelagics 20–400 mbsf: uplifted trench turbidites ~400 mbsf: frontal thrust 400–830 mbsf: trench wedge turbidites 830–1050 mbsf: upper Shikoku Basin hemipelagics and volcanic ash 1050–2700 mbsf: lower Shikoku Basin hemipelagics and turbidites

Site summaries (continued)

Proposed Site NT1-03B

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) • *Chikyu* Expedition 316 (Thrust Faults)
Position:	33°1.635′N, 136°47.639′E
Water depth (m)	3832
Target drilling depth (mbsf):	950 sediment (Stage 1)
Approved maximum penetration (mbsf):	1800; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS survey; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF15**) • CDEX/IFREE 3-D inline (Fig. **AF16**)
Objective (see text for full details):	Penetrate the toe of the Nankai accretionary prism to: • Characterize incoming sedimentary sequence (lithologic, hydrologic, thermal, geotechnical, geochemical properties) • Document early phases of deformation • Verify location of frontal décollement Although penetration to basement is desirable, a more important goal is to sample as much of the lower Shikoku Basin as possible.
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314 (LWD): • Pilot hole - MWD • Hole A - MWD/LWD to TD *Chikyu* Expedition 316 (Thrust Faults): Hole B (if TD cannot be achieved, start Hole C): • APC/XCB • Core orientation • Downhole temperature measurements Hole C: • Drill without coring to depth of Hole B • RCB core to TD • Wireline logging as contingency if Expedition 314 LWD is not accomplished
Anticipated lithology:	0–20 mbsf: hemipelagics and volcanic ash 20–600 mbsf: uplifted trench turbidites ~600 mbsf: frontal thrust 600–1100 mbsf: trench wedge turbidites 1100–1400 mbsf: upper Shikoku Basin hemipelagics and volcanic ash 1400–2800 mbsf: lower Shikoku Basin hemipelagics and turbidites

Site summaries (continued)

Proposed Site NT1-03C

Priority:	Alternate for proposed Site NT1-03B
Position:	33°2.000′N, 136°47.403′E
Water depth (m):	3790
Target drilling depth (mbsf):	950 sediment (Stage 1)
Approved maximum penetration (mbsf):	1800; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF15**) • CDEX/IFREE 3-D inline (Fig. **AF16**)
Objective (see text for full details):	Penetrate the toe of the Nankai accretionary prism to: • Characterize incoming sedimentary sequence (lithologic, hydrologic, thermal, geotechnical, geochemical properties) • Document early phases of deformation • Verify location of frontal décollement Although penetration to basement is desirable, a more important goal is to sample as much of the lower Shikoku Basin as possible.
Drilling, coring, and downhole measurement program:	See **NT1-03B**
Anticipated lithology:	0–200 mbsf: hemipelagics and slumped trench material 200–850 mbsf: uplifted trench turbidites ~850 mbsf: frontal thrust 850–1290 mbsf: trench wedge turbidites 1290–1550 mbsf: upper Shikoku Basin hemipelagics and volcanic ash 1550–2920 mbsf: lower Shikoku Basin hemipelagics and turbidites

Site summaries (continued)

Proposed Site NT1-04C

Priority:	Alternate for proposed Site NT1-07A
Position:	32°54.000′N, 136°51.110′E
Water depth (m):	4355
Target drilling depth (mbsf):	1400 (1300 m sediment)
Approved maximum penetration (mbsf):	1500; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	IFREE 3-D 2006 seismic survey; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF4**) • IFREE 3-D Inline 95 (Figs. **AF5, AF17**) • IFREE 3-D Crossline 1151 (Fig. **AF18**) • 2-D KR Line 0211 (Fig. **AF19**)
Objective (see text for full details):	Reference site: • Penetrate entire sedimentary section • Complete characterization of Shikoku Basin strata and upper igneous basement where basement topography is relatively flat • Document lithologic, hydrologic, thermal, geotechnical, and geochemical properties of subduction inputs • Log-seismic integration
Drilling, coring, and downhole measurement program:	See **NT1-07A**
Anticipated lithology:	0–400 mbsf: upper Shikoku Basin hemipelagics and volcanic ash 400–800 mbsf: lower Shikoku Basin hemipelagics and volcanic ash 800–1200 mbsf: lower Shikoku Basin hemipelagics and turbidite sands >1200 mbsf: volcaniclastic sediments and basalt

Site summaries (continued)

Proposed Site NT1-07A

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) Alternate: • Other Stage 1 expeditions
Position:	32°49.7300′N, 136°52.8900′E
Water depth (m):	4062
Target drilling depth (mbsf):	1200 m sediment (stop at basement contact)
Approved maximum penetration (mbsf):	1400; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	Extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track maps (Figs. **AF20, AF4**) • Line odkm 03-101 SP 2524 (Fig. **AF21**) • IFREE 3-D InLine 95 (Figs. **AF5, AF22**)
Objective (see text for full details):	Reference site: • Penetrate entire sedimentary section • Complete characterization of Shikoku Basin strata and upper igneous basement where basement topography is relatively flat and the lower Shikoku Basin sand facies is well-developed • Document lithologic, hydrologic, thermal, geotechnical, and geochemical properties of subduction inputs • Log-seismic integration
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314 (LWD): Hole A - MWD/LWD to basement contact
Anticipated lithology:	0–400 mbsf: upper Shikoku Basin hemipelagics and volcanic ash 400–800 mbsf: lower Shikoku Basin hemipelagics and volcanic ash 800–1200 mbsf: lower Shikoku Basin hemipelagics and turbidite sands >1200 mbsf: volcaniclastic sediments and basalt

Site summaries (continued)

Proposed Site NT2-01B

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) • *Chikyu* Expedition 316 (Thrust Faults)
Position:	33°13.3200′N, 136°42.2000′E
Water depth (m):	2391
Target drilling depth (mbsf):	1000 m sediment
Approved maximum penetration (mbsf):	1200; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF23**) • 3-D Inline 2596 (Figs. **AF24, AF25**) • 3-D Crossline 5375 (Fig. **AF26**)
Objective (see text for full details):	Characterization of active splay fault and fluid flow regime by core sampling, logging, crosshole experiments and long-term monitoring Focus on mechanical and hydrological properties (e.g., strength, pore pressure, permeability, porosity), fluid budget, origin of the fluid, detection of episodic flow Borehole long-term observatory for hydrogeological properties and crosshole testing planned for future stages
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314 (LWD): Hole A - MWD/LWD to 1000 m *Chikyu* Expedition 316 (Thrust Faults): Hole B: • Jet-in test • APC/XCB coring and downhole measurements (temperature, core orientation) Hole C: • Install reentry cone and casing • RCB coring to TD • Case hole to TD • Wireline logging only as contingency in case *Chikyu* Expedition 314 LWD is not successful
Anticipated lithology:	0–100 mbsf: slope sediments 100–610 mbsf: accretionary prism (deformed, compacted turbidites) ~610 mbsf: megasplay fault 610–910 mbsf: younger slope sediments >910 mbsf: older accretionary prism sediments and rocks

Site summaries (continued)

Proposed Site NT2-01C

Priority:	Alternate for proposed Site NT2-01B
Position:	33°13.7035′N, 136°43.0353′E
Water depth (m):	2304
Target drilling depth (mbsf):	1000 m sediment
Approved maximum penetration (mbsf):	1200; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**) Track map (Fig. **AF23**) 3-D Crossline 5375 (Fig. **AF26**) 3-D InLine 2675 (Figs. **AF27, AF28**)
Objective (see text for full details):	Characterization of active splay fault and fluid flow regime by core sampling, logging, crosshole experiments and long-term monitoring. Focus on mechanical and hydrological properties (e.g., strength, pore pressure, permeability, porosity), fluid budget, origin of the fluid, detection of episodic flow Borehole long-term observatory for hydrogeological properties and crosshole testing is planned for future stages
Drilling, coring, and downhole measurement program:	See **NT2-01B**
Anticipated lithology:	0–100 mbsf: slope sediments 100–610 mbsf: accretionary prism (deformed, compacted turbidites) ~610 mbsf: megasplay fault 610–910 mbsf: younger slope sediments >910 mbsf: older accretionary prism sediments and rocks

Site summaries (continued)

Proposed Site NT2-03B

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) • *Chikyu* Expedition 315 (Megasplay Riser Pilot)
Position:	33°14.30′N, 136°42.65′E
Water depth (m):	2178
Target drilling depth (mbsf):	1000 m
Approved maximum penetration (mbsf):	1250; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF23**) • 3-D Inline 2675 (Figs. **AF27, AF28**) • 3-D Crossline 5475 (Fig. **AF29**)
Objective (see text for full details):	Sample forearc basin sediments and deformed prism Preparatory site for 3.5 km deep Stage 2 riser site (Stage 2 will characterize megasplay fault zone system by intersecting it at intermediate depth of 3.5 km) Integration with proposed Sites NT2-01A and NT3-01 is essential
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314 (LWD): • Pilot hole using MWD • Hole A - MWD/LWD to 1000 m *Chikyu* Expedition 315 (Megasplay Riser Pilot): Hole B: • Jet-in test • APC/XCB coring and downhole measurements (temperature, core orientation) Hole C: • Deploy reentry cone and 20 inch casing in case TD is not reached in pilot and LWD holes • Drill without coring to depth of Hole B • 13-3/8 inch casing if required • RCB core to TD • Wireline logging (triple combo, FMS-Sonic) only as contingency in case *Chikyu* Expedition 314 LWD is not successful Hole D: • Initiate riser drill hole • Install 36 inch conductor casing • Drill 26 inch hole to 700 mbsf • Install and cement 20 inch casing
Anticipated lithology:	0–210 mbsf: slope sediments 210–800 mbsf: accretionary prism (deformed, compacted turbidites)

Site summaries (continued)

Proposed Site NT2-03C

Priority:	Alternate for proposed Site NT2-03B
Position:	33°13.9075′N, 136°41.811′E
Water depth (m):	2145
Target drilling depth (mbsf):	1000 m sediment
Approved maximum penetration (mbsf):	1250; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF23**) • 3-D InLine 2596 (Fig. **AF28**) • 3-D CrossLine 5475 (Fig. **AF29**)
Objective (see text for full details):	Sample forearc basin sediments and deformed prism Preparatory site for 3.5 km deep Stage 2 riser site (Stage 2 will characterize megasplay fault zone system by intersecting it at intermediate depth of 3.5 km) Integration with proposed Sites NT2-01A and NT3-01 is essential.
Drilling, coring, and downhole measurement program:	See **NT2-03B**
Anticipated lithology:	0–210 mbsf: slope sediments 210–800 mbsf: accretionary prism (deformed, compacted turbidites)

Site summaries (continued)

Proposed Site NT2-04B

Priority:	Alternate for proposed Site NT3-01B
Position:	33°23.05′N, 136°36.46′E
Water depth (m):	2000
Target drilling depth (mbsf):	1400 m sediment
Approved maximum penetration (mbsf):	1400; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (**www.iodp.org/nantroseize-downloads**): • Track map (Fig. **AF30**) • 3-D InLine 2645 (Fig. **AF31, AF32**) • 3-D CrossLine 6980 (Fig. **AF33**)
Objective (see text for full details):	Total history of the splay fault system is depicted by integrating the results from proposed Site NT3-01 as a reference for this site.
Drilling, coring, and downhole measurement program:	See **NT3-01B**
Anticipated lithology:	0–1039 mbsf: slope basin sediments; rapidly deposited sand/silts/clays ~420 mbsf: bottom-simulating reflector 1039–1400 mbsf: older accreted prism

Site summaries (continued)

Proposed Site NT3-01B

Priority:	Primary: • *Chikyu* Expedition 314 (LWD) Alternate for all other Stage 1 expeditions
Position:	33°18.020′N, 136°38.180′E
Water depth (m):	1966
Target drilling depth (mbsf):	1400
Approved maximum penetration (mbsf):	1400; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603C-Full (**www.iodp.org/nantroseize-downloads**) • Track map (Fig. **AF30**) • 3-D InLine 2529 (Figs. **AF34, AF35**) • 3-D CrossLine 6225 (Fig. **AF36**)
Objective (see text for full details):	Determine splay fault history and nature of prism below basin sediments Preparatory site for deep (~5.5–6.0 km) riser drilling
Drilling, coring, and downhole measurement program:	*Chikyu* Expedition 314 (LWD): • Hole A - MWD/LWD • 9-5/8 inch casing to 1000 mbsf as required
Anticipated lithology:	0–1039 mbsf: slope basin sediments; rapidly deposited sand/silts/clays ~420 mbsf: bottom-simulating reflector 1039–1400 mbsf: older accreted prism

Site summaries (continued)

Proposed Site NT3-01C

Priority:	Alternate for proposed Site NT3-01B
Position:	33°18.650′N, 136°40.120′E
Water depth (m):	2046
Target drilling depth (mbsf):	1400
Approved maximum penetration (mbsf):	1400; approved by CDEX and TAMU safety panels based on EPSP Jan 2007 recommendation
Survey coverage:	CDEX 2006 3-D MCS; extensive survey data outlined in Proposal 603A-Full2 (www.iodp.org/nantroseize-downloads): • Track map (Fig. AF30) • 3-D InLine 2700 (Figs. AF37, AF38) • 3-D CrossLine 6190 (Fig. AF39)
Objective (see text for full details):	Core and conduct downhole measurements throughout the entire forearc basin section and uppermost portion of the underlying prism Determine splay fault history and nature of prism below basin sediments Preparatory site for deep (~5.5–6.0 km) riser drilling
Drilling, coring, and downhole measurement program:	See NT3-01B
Anticipated lithology:	0–1039 mbsf: slope basin sediments; rapidly deposited sand/silts/clays ~420 mbsf: bottom-simulating reflector 1039–1400 mbsf: older accreted prism

Figure AF1. Track map, Site NT1-01A.

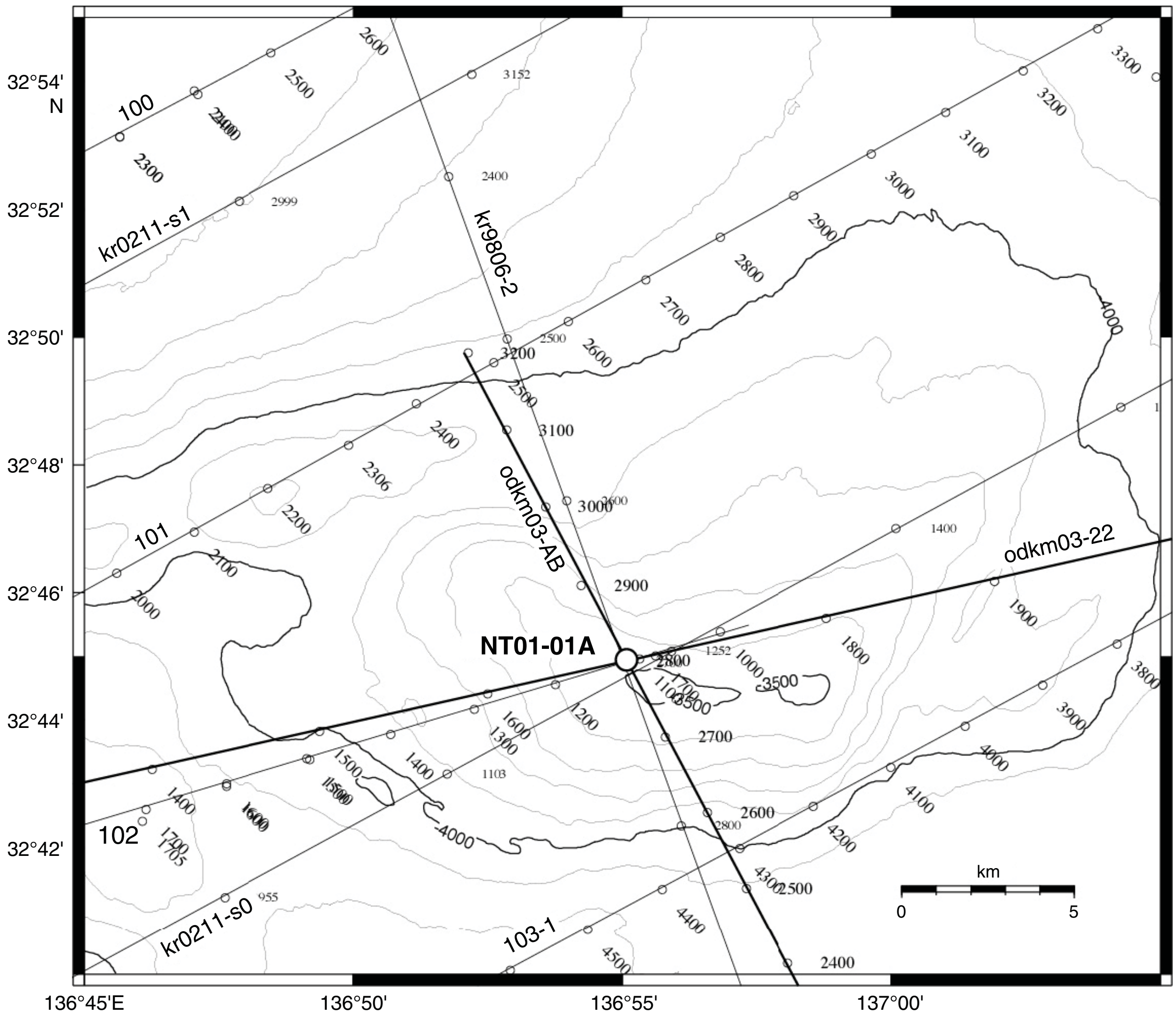


Figure AF2. Line ODKM03-AB.

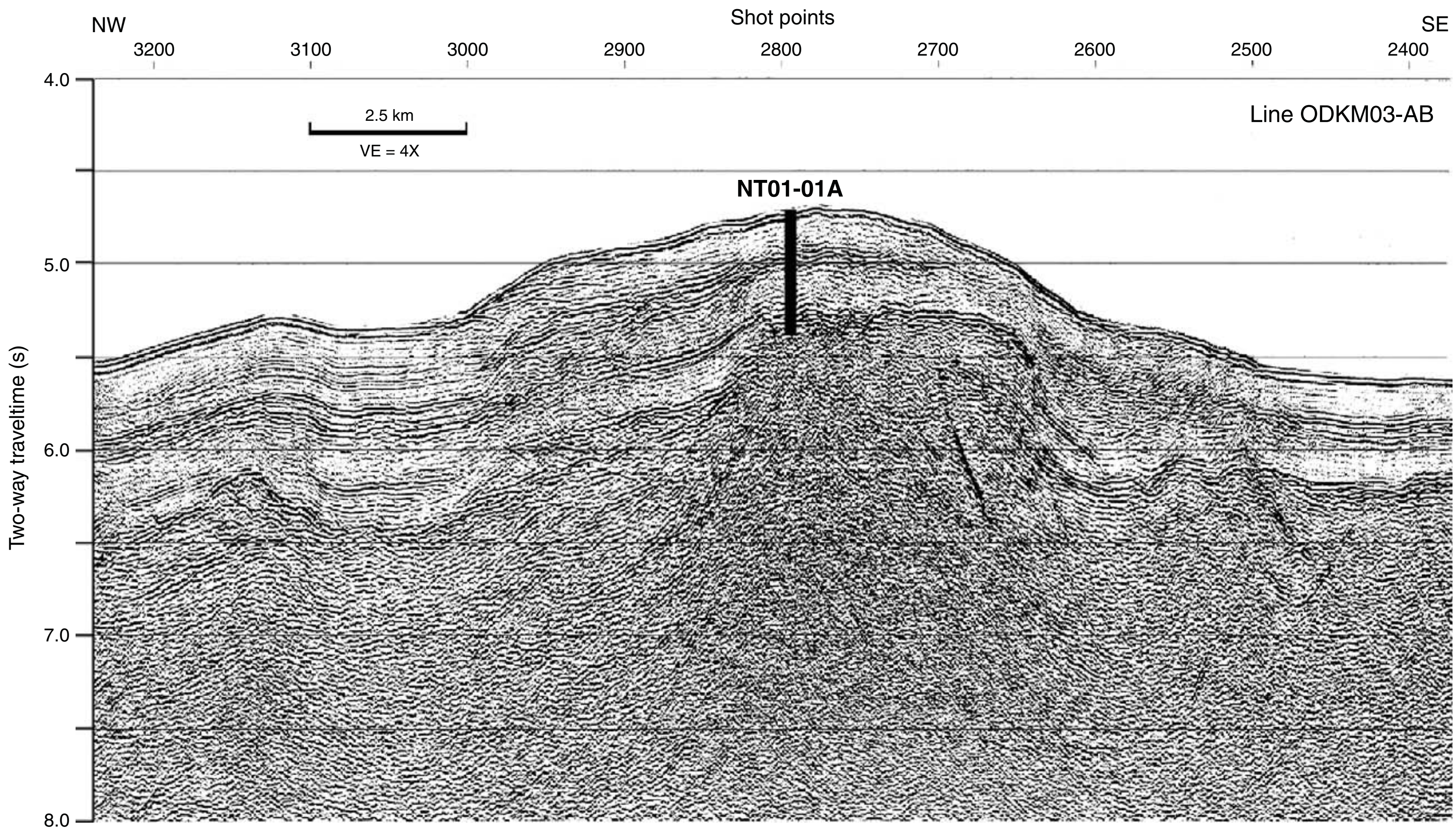


Figure AF3. Line ODKM03-22.

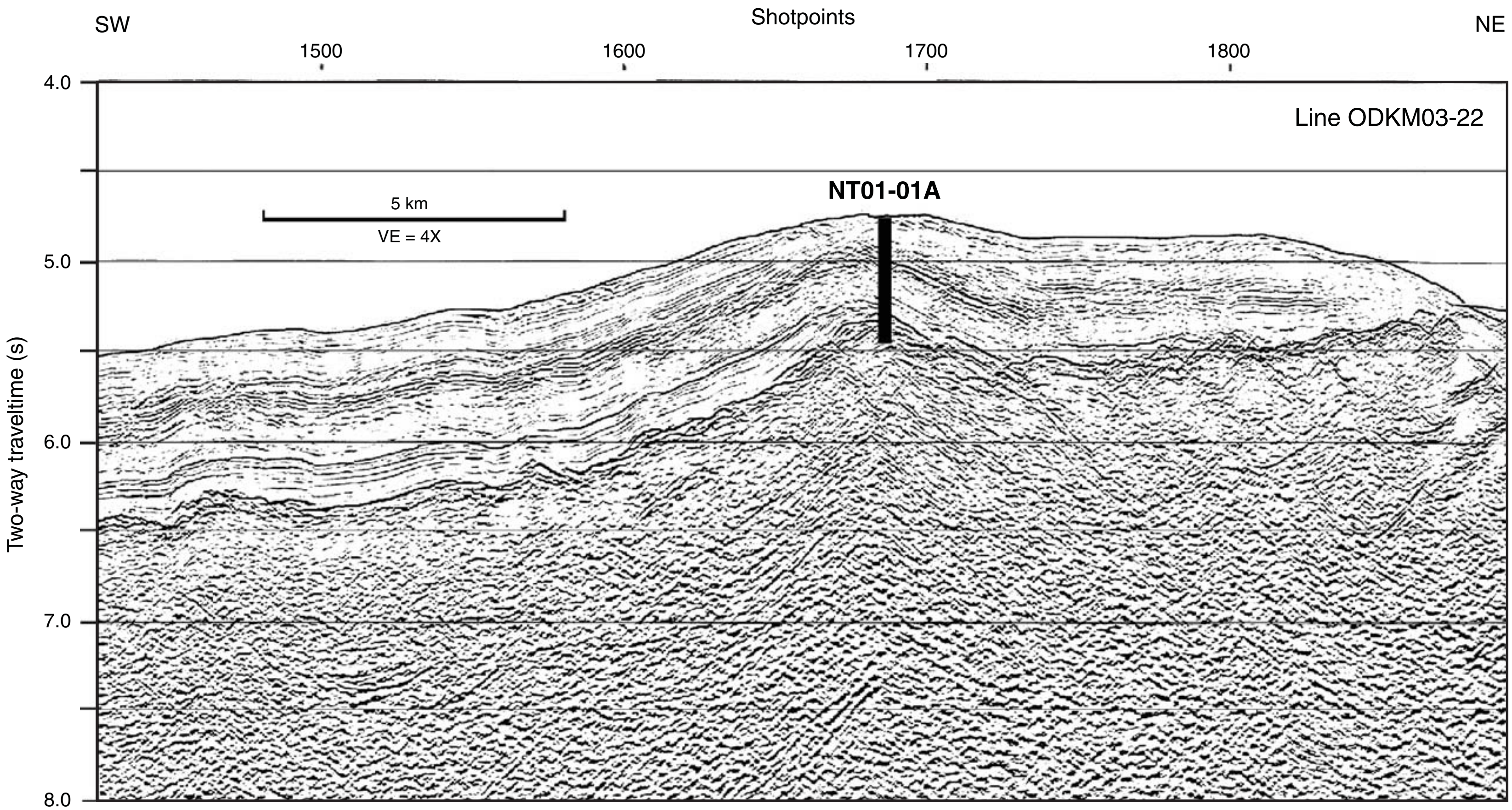


Figure AF4. Track map, Site NT1-04C.

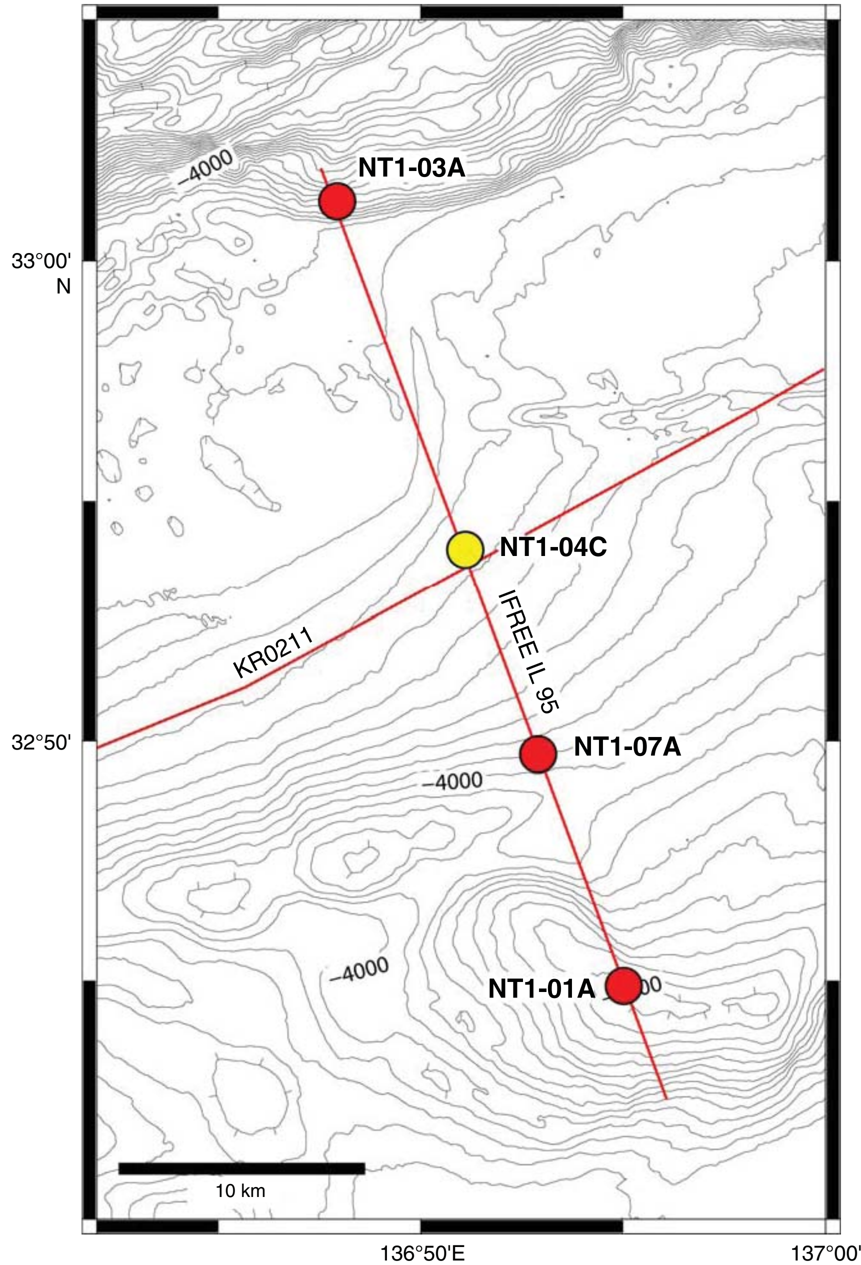


Figure AF5. Inline 95.

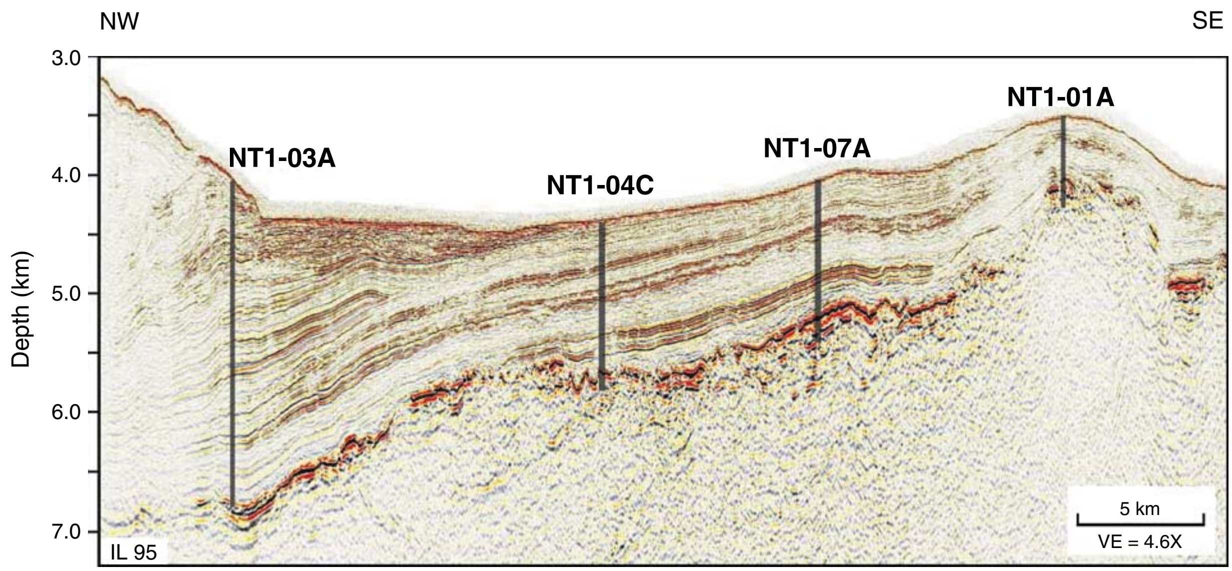


Figure AF6. Inline 95.

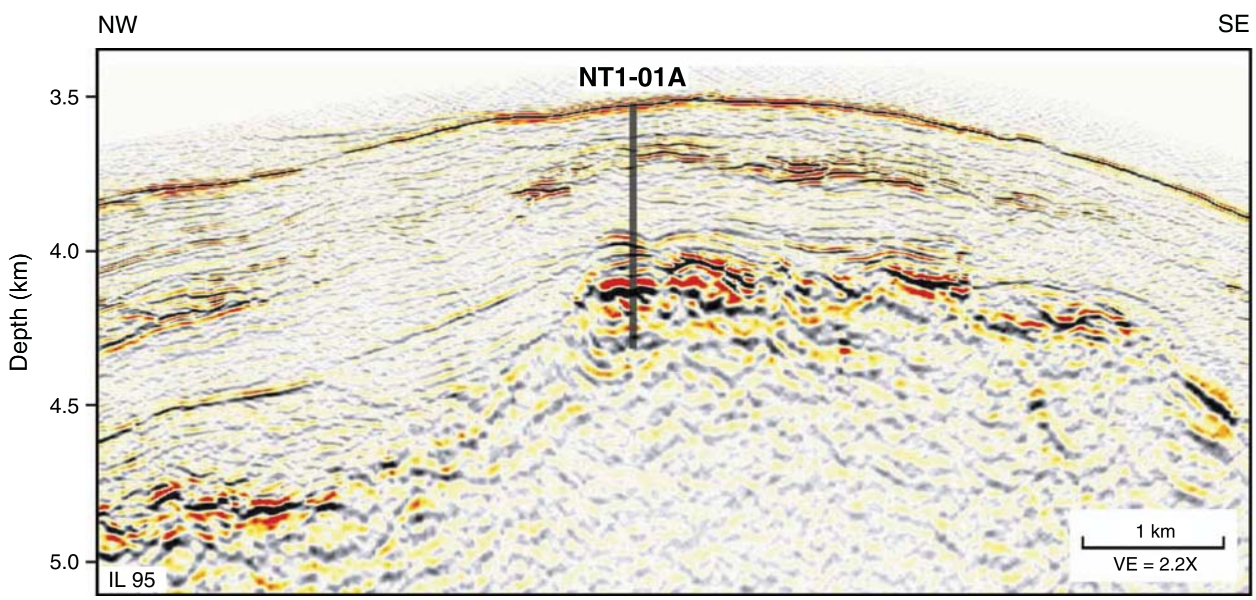


Figure AF7. Track map, Site NT1-02A.

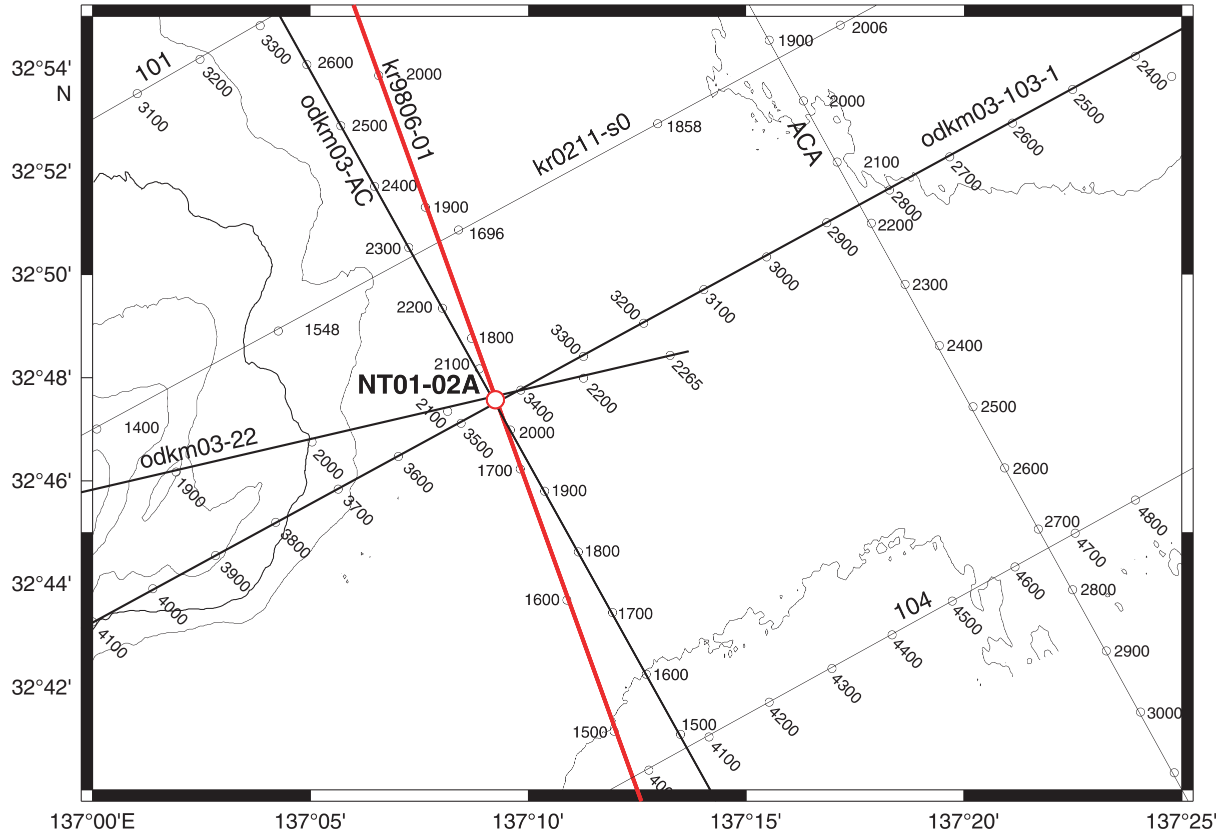


Figure AF8. Line ODKM03-22.

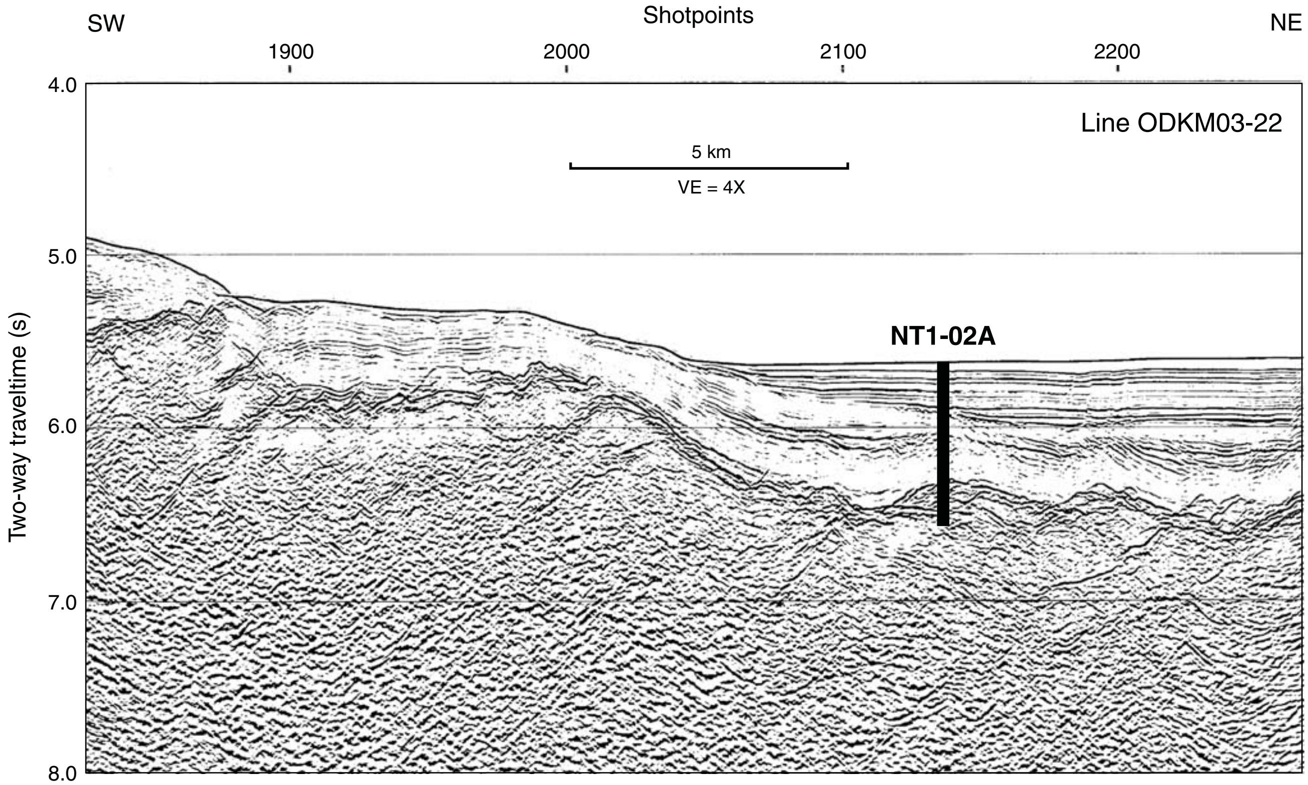


Figure AF9. Line ODKM03-103-1.

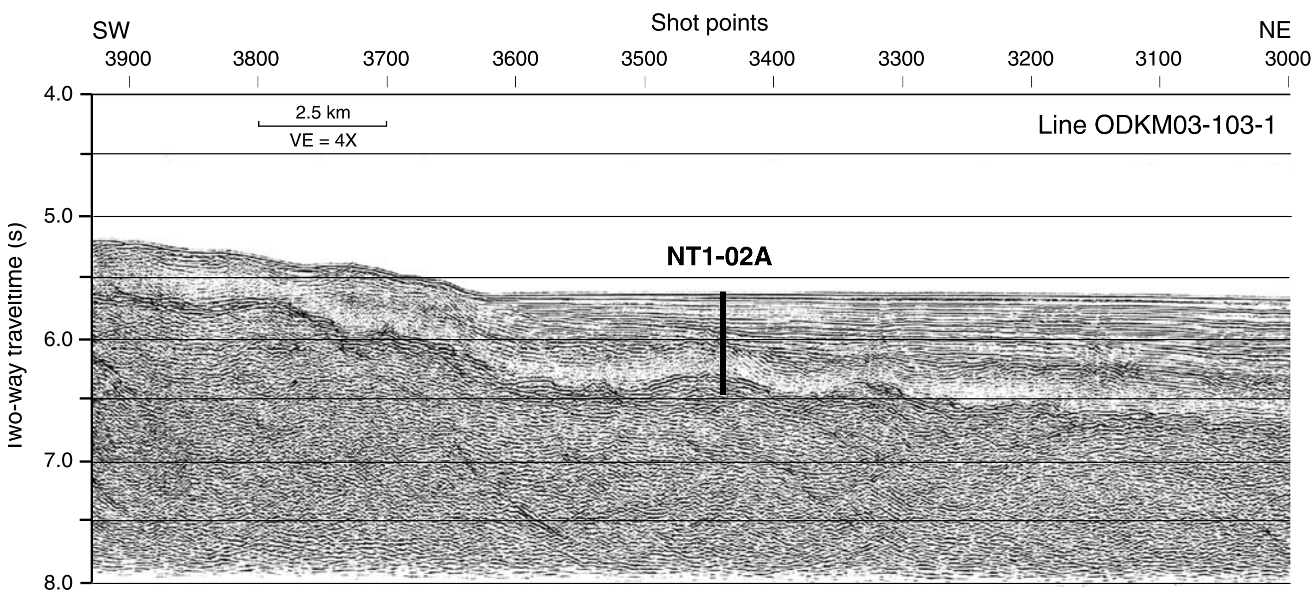


Figure AF10. Line KR9806-1.

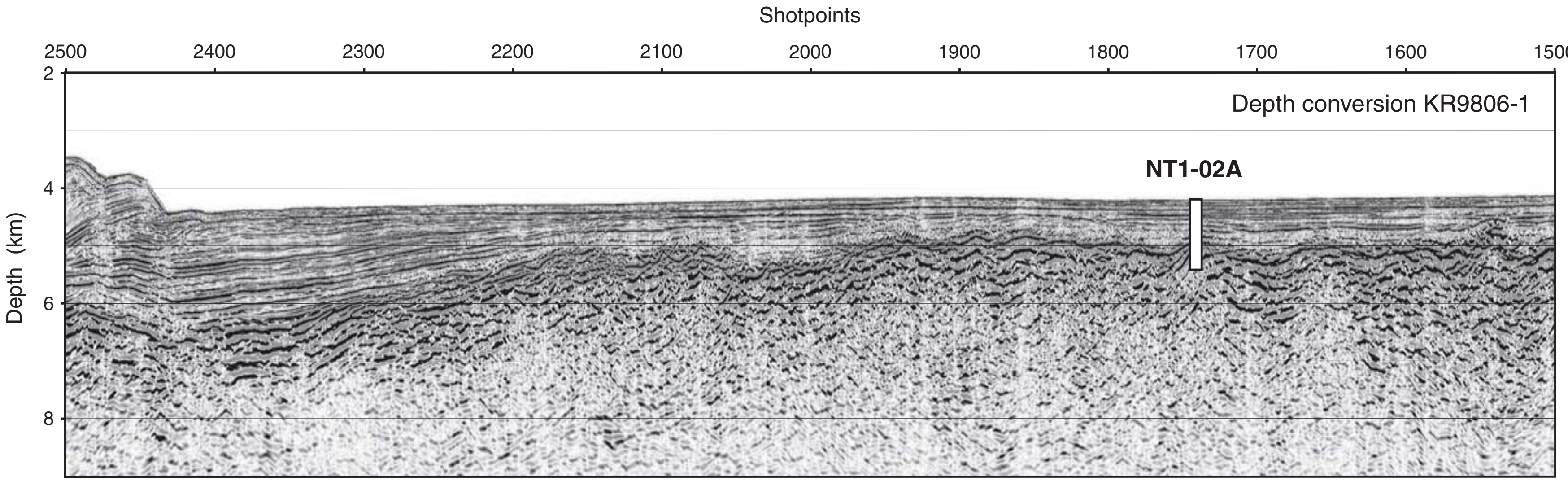


Figure AF11. Track map, Site NT1-03A.

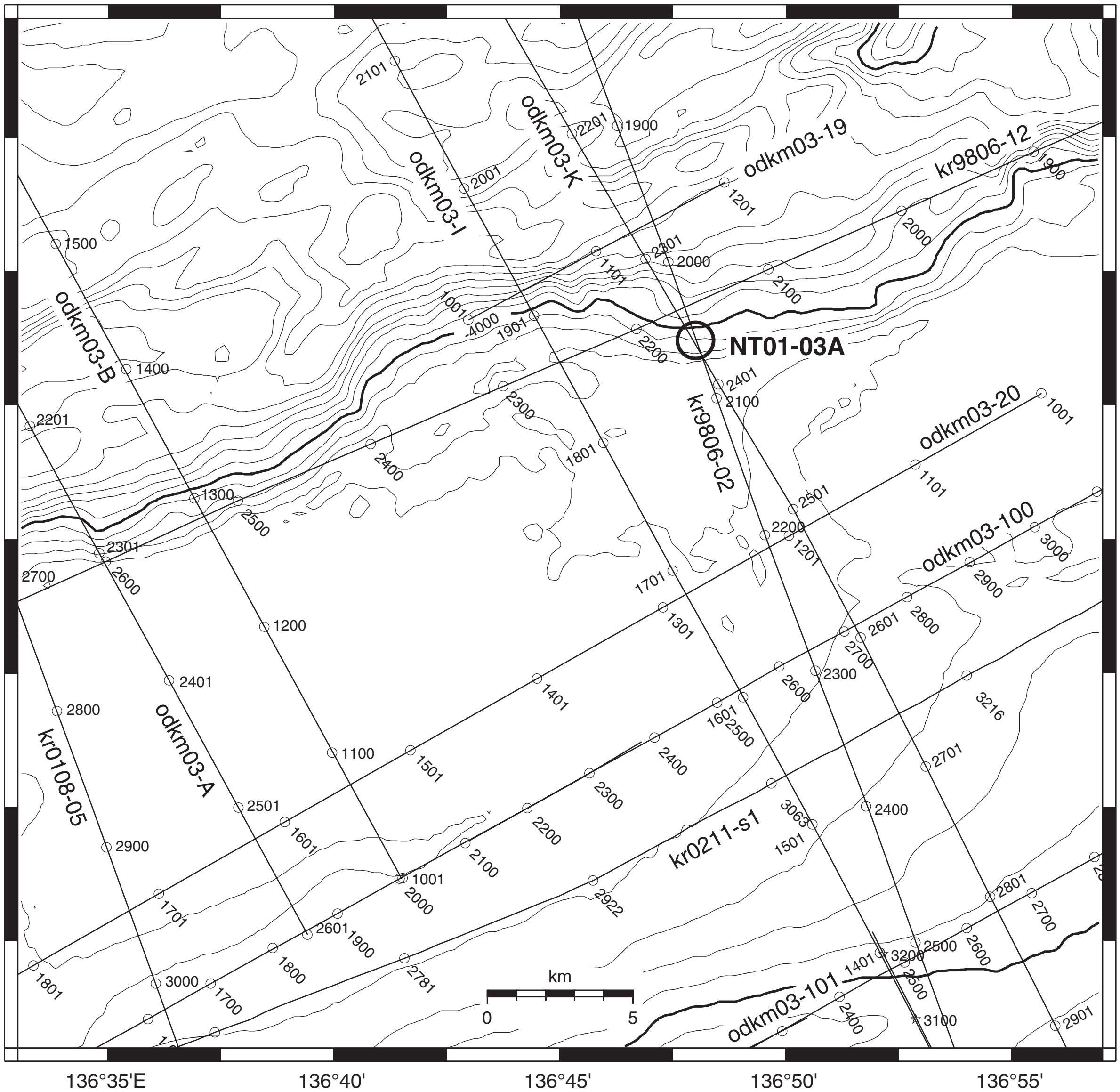


Figure AF12. Line ODKM03-K.

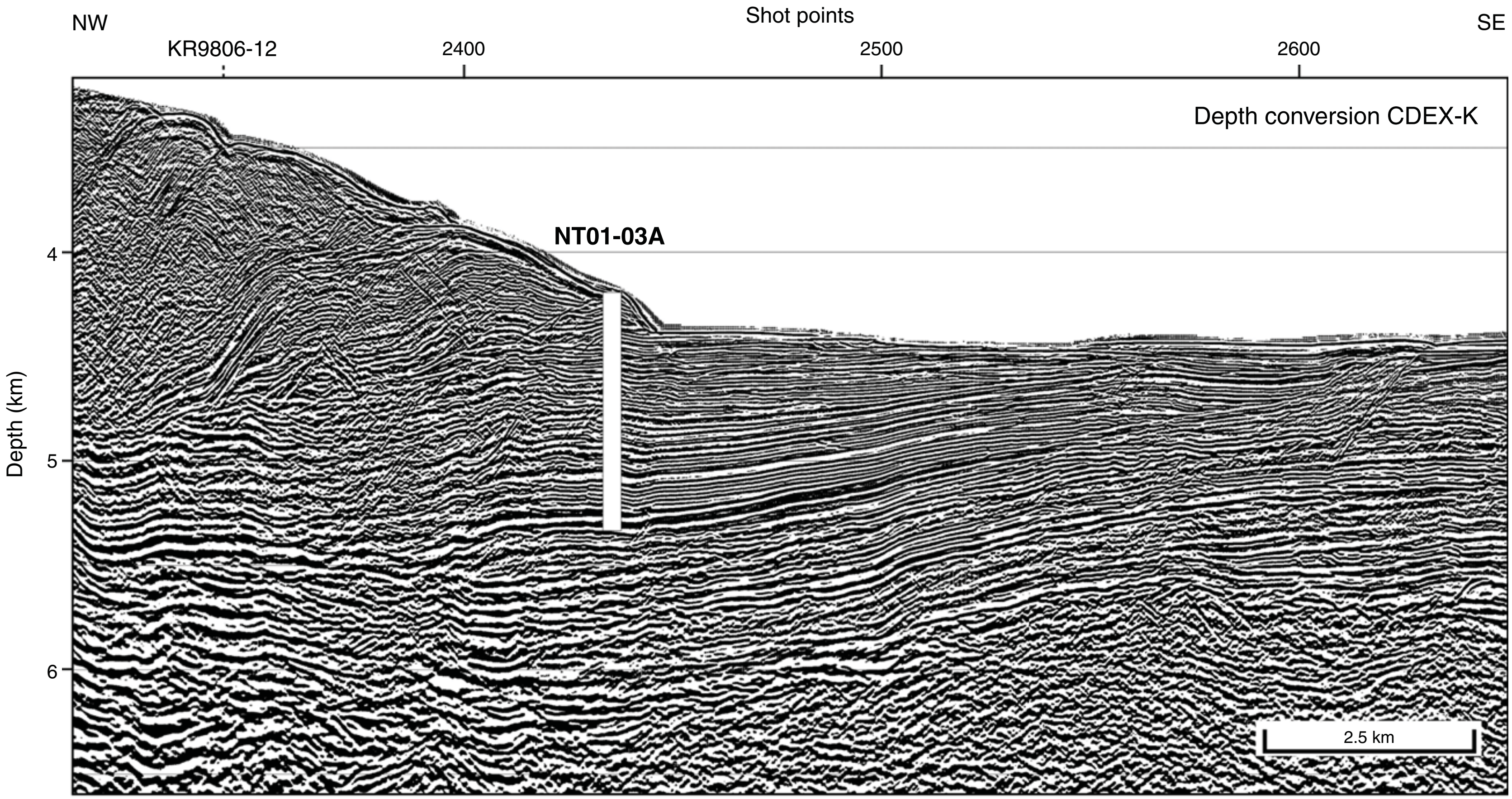


Figure AF13. Line KR9806-12.

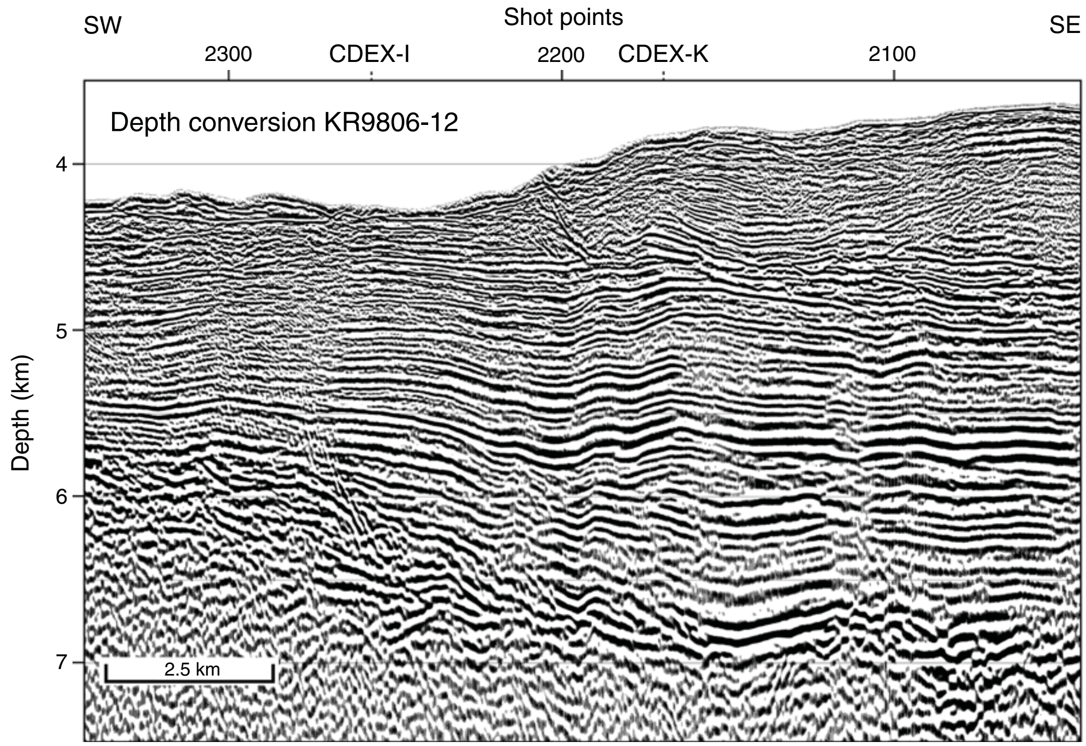


Figure AF14. Inline.

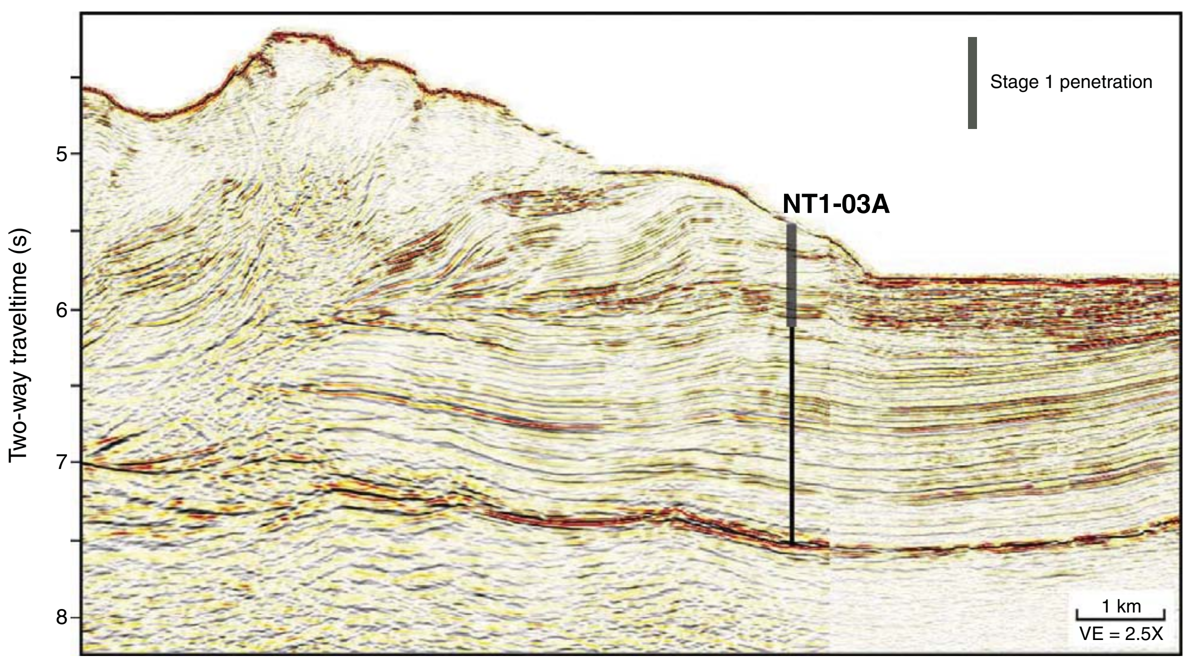


Figure AF15. Site map, NT1-03.

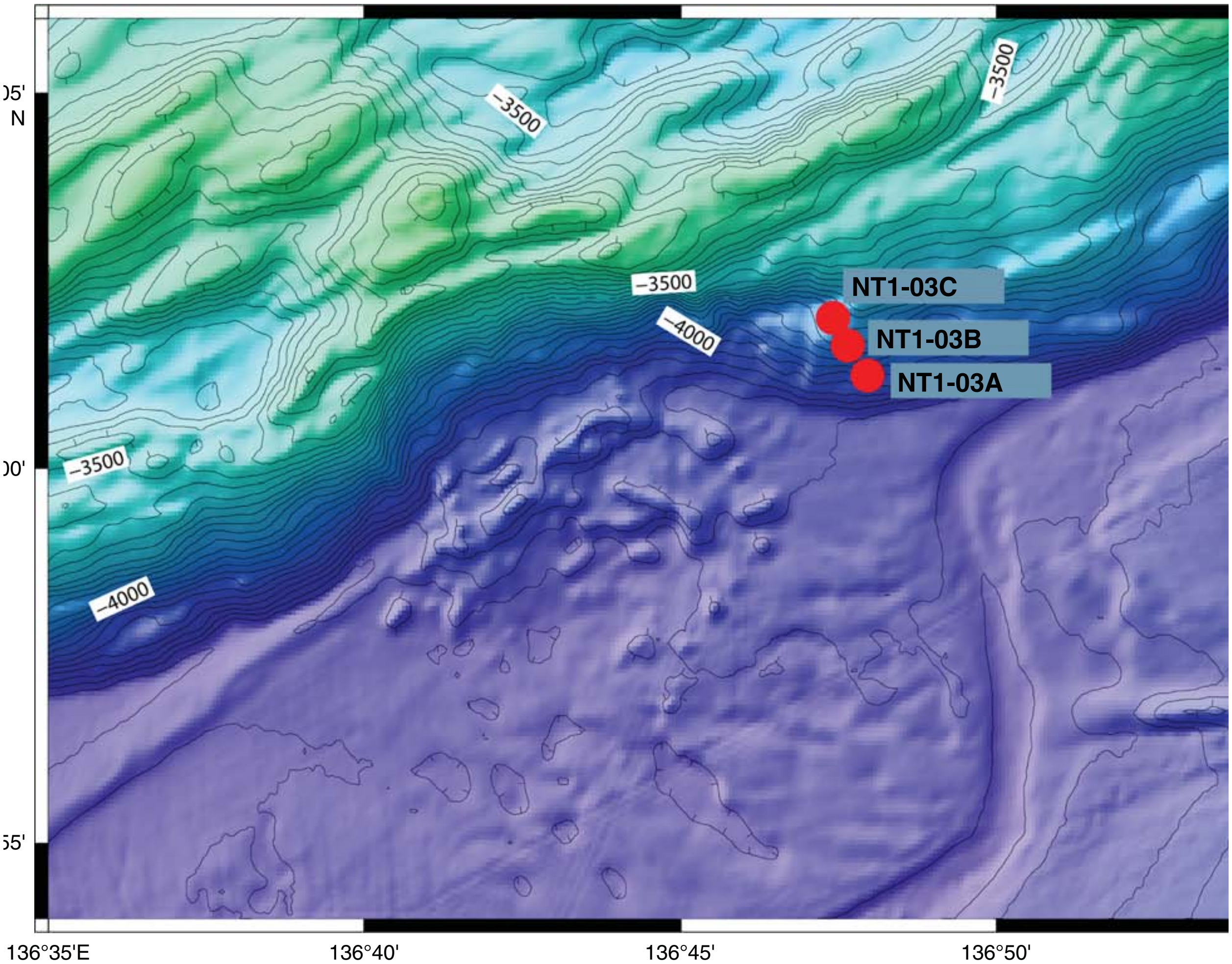


Figure AF16. Inline.

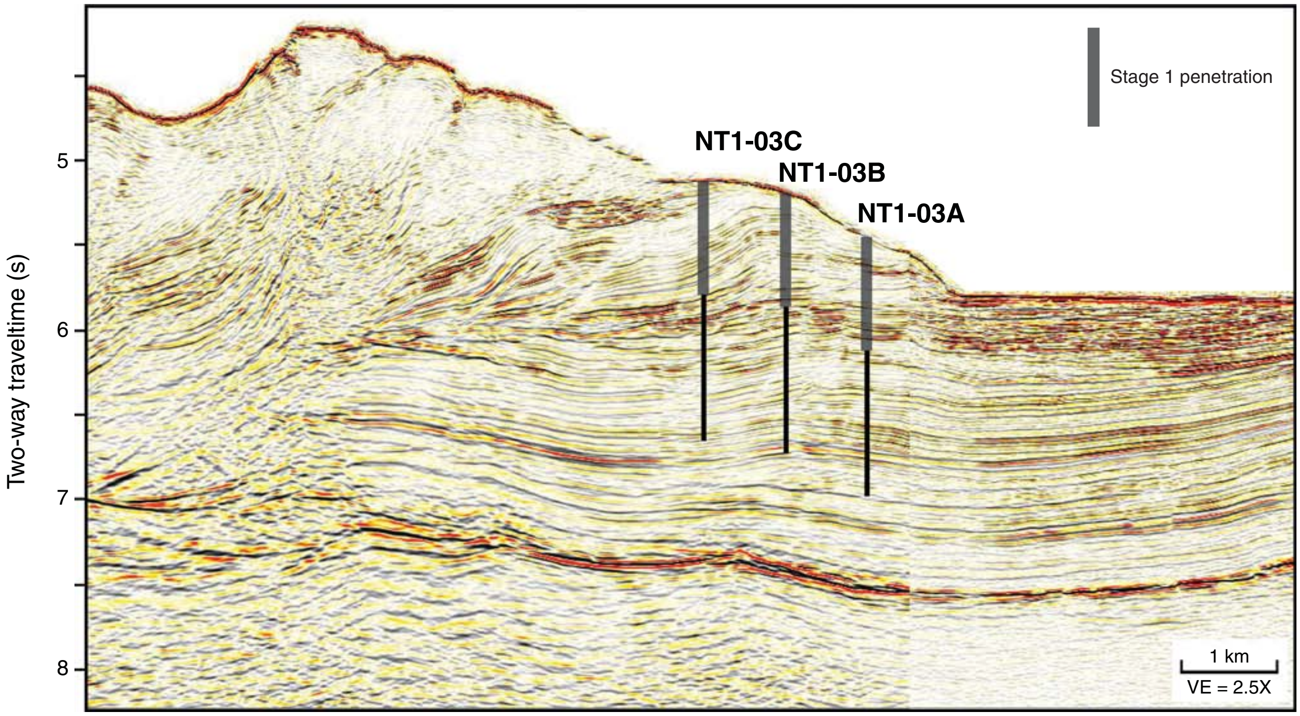


Figure AF17. Inline 95.

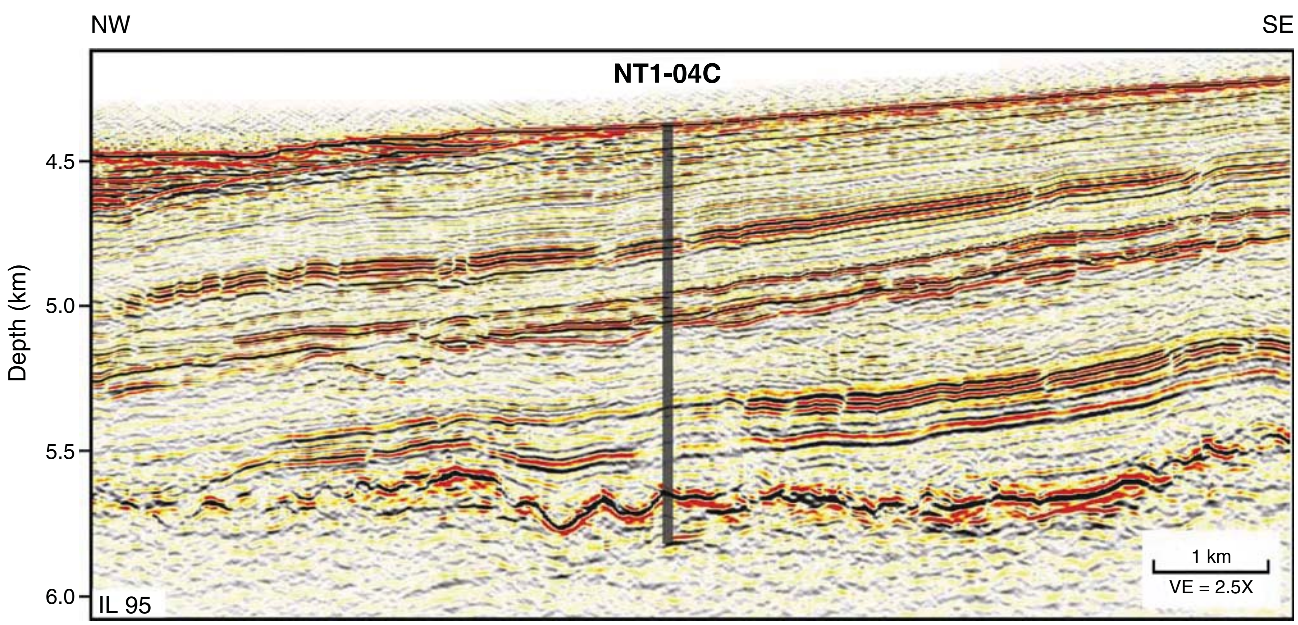


Figure AF18. Line 1151.

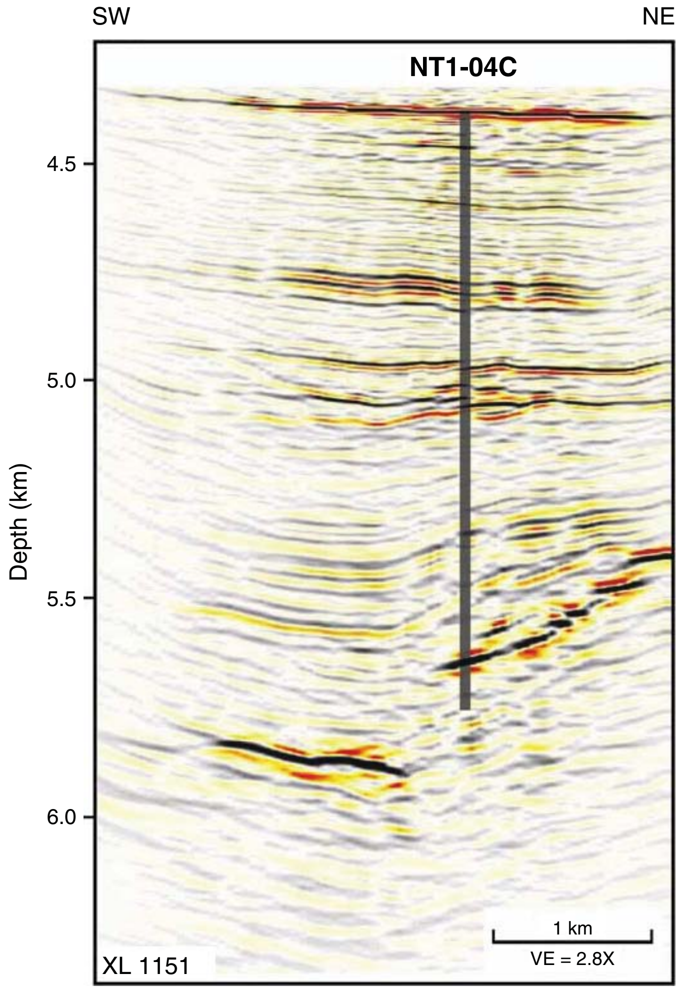


Figure AF19. Line KR0211.

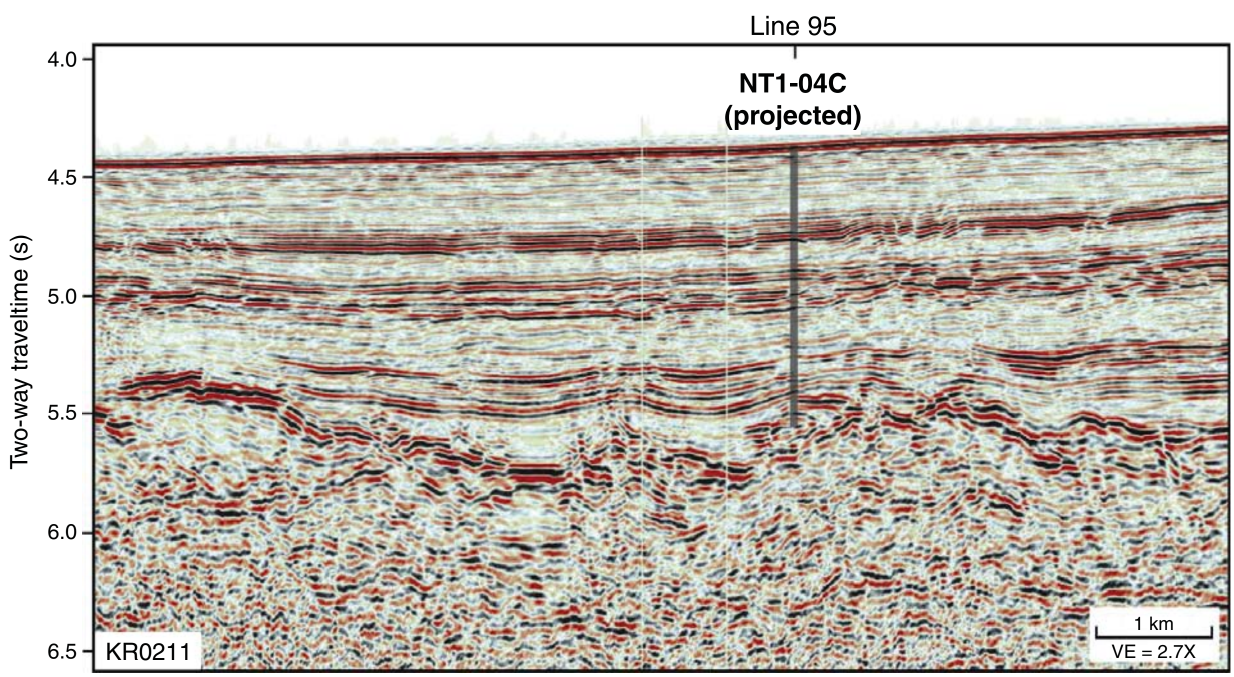


Figure AF20. Track map, Site NT1-07A.

Figure AF21. Line ODKM 03-101.

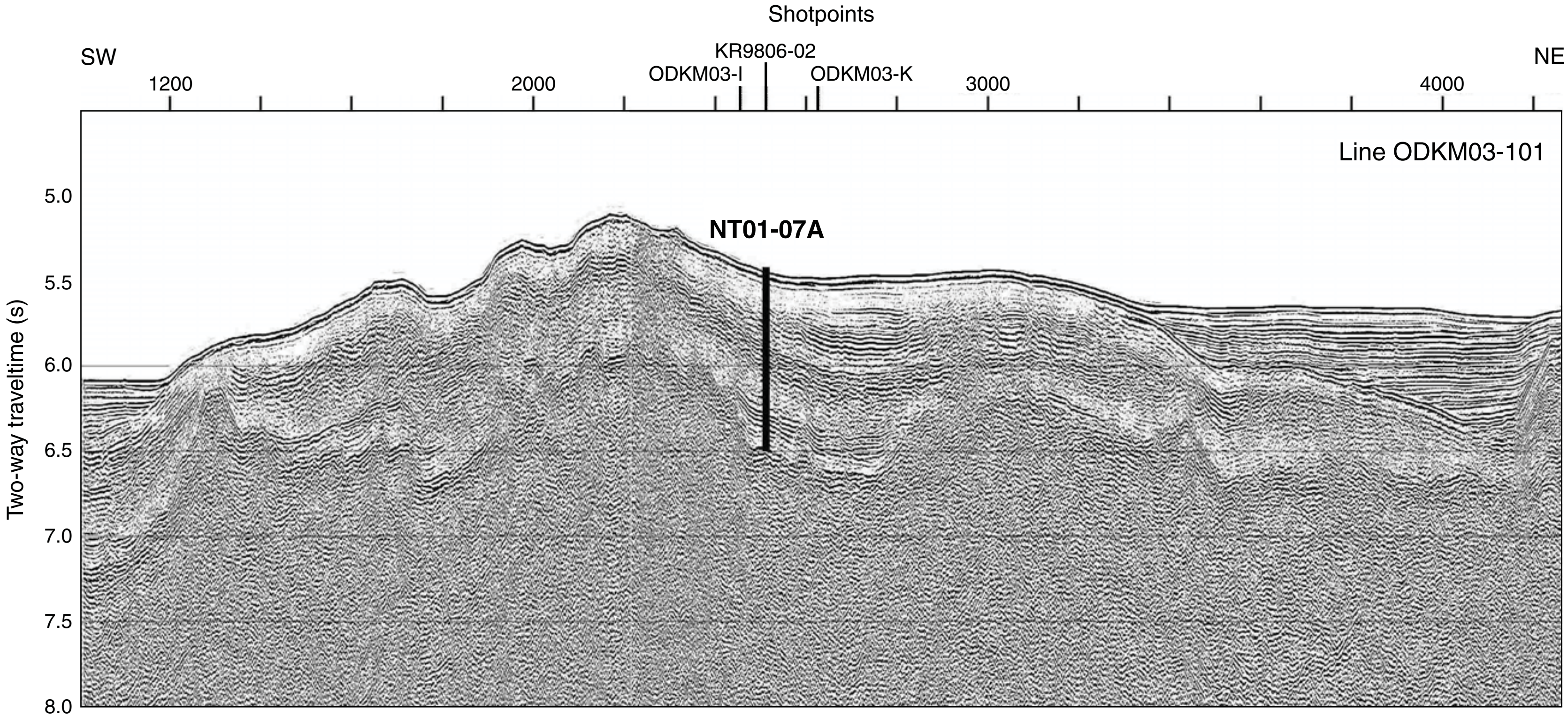


Figure AF22. Inline 95.

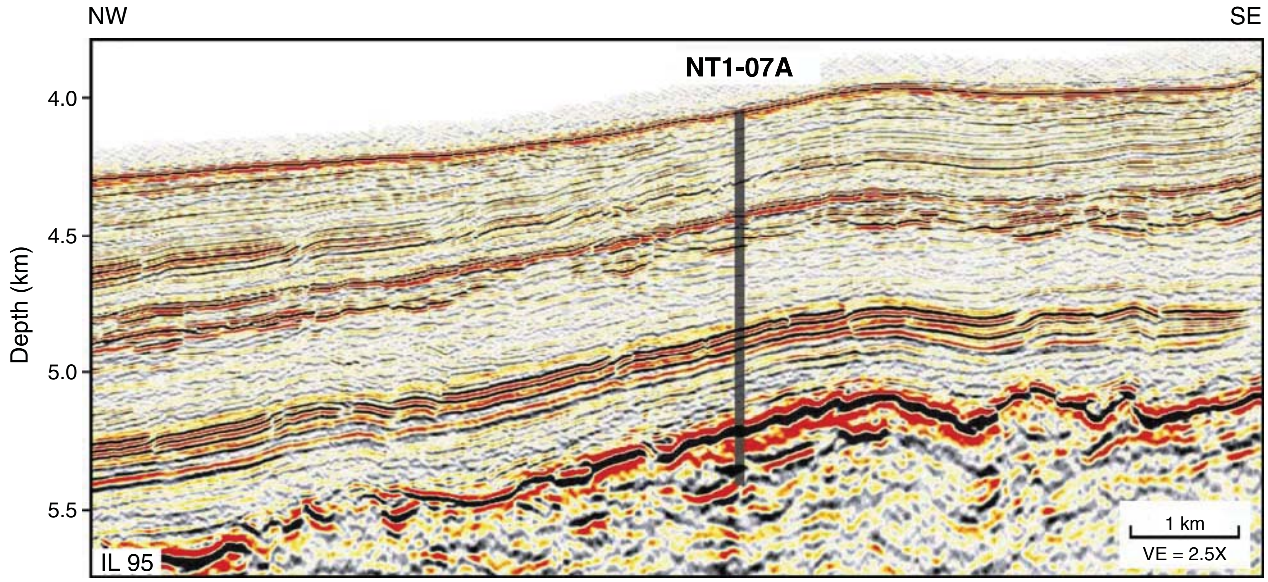


Figure AF23. Track map, Sites NT2-01 and 03.

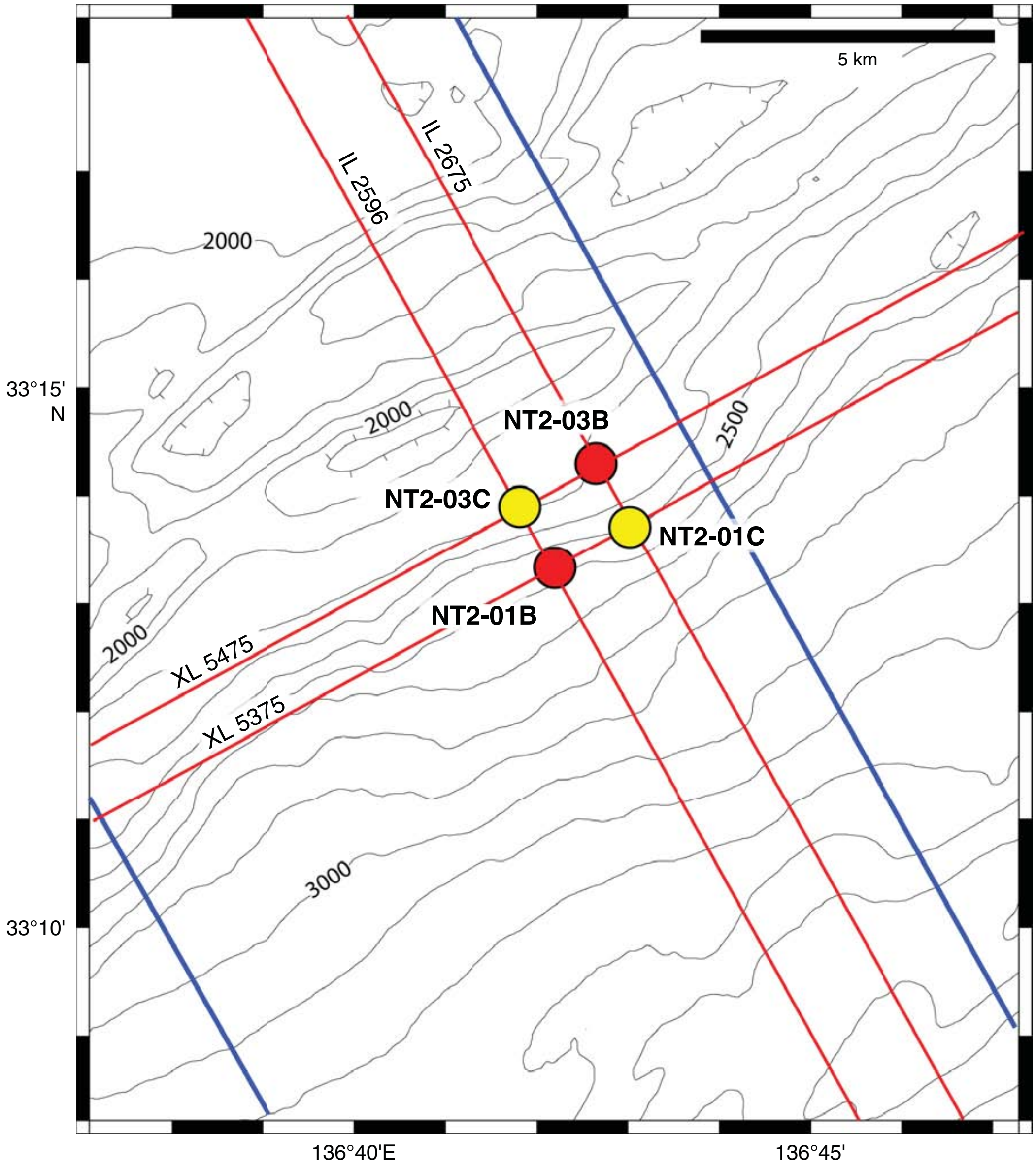


Figure AF24. Inline 2596.

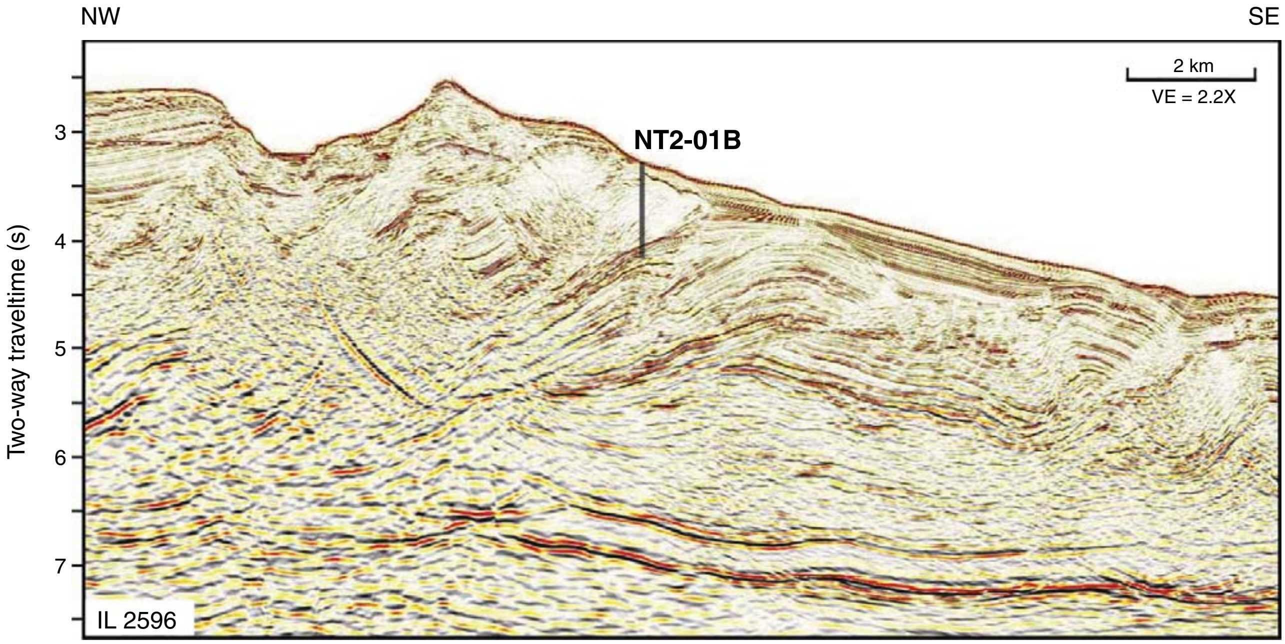


Figure AF25. Inline 2596.

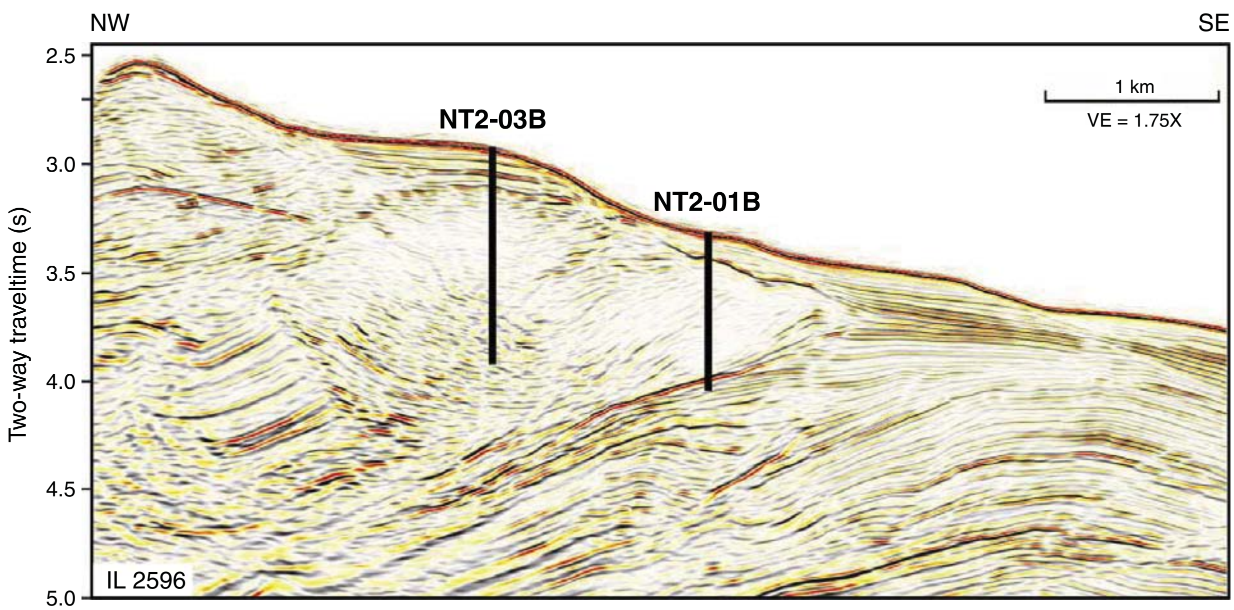


Figure AF26. Crossline 5375.

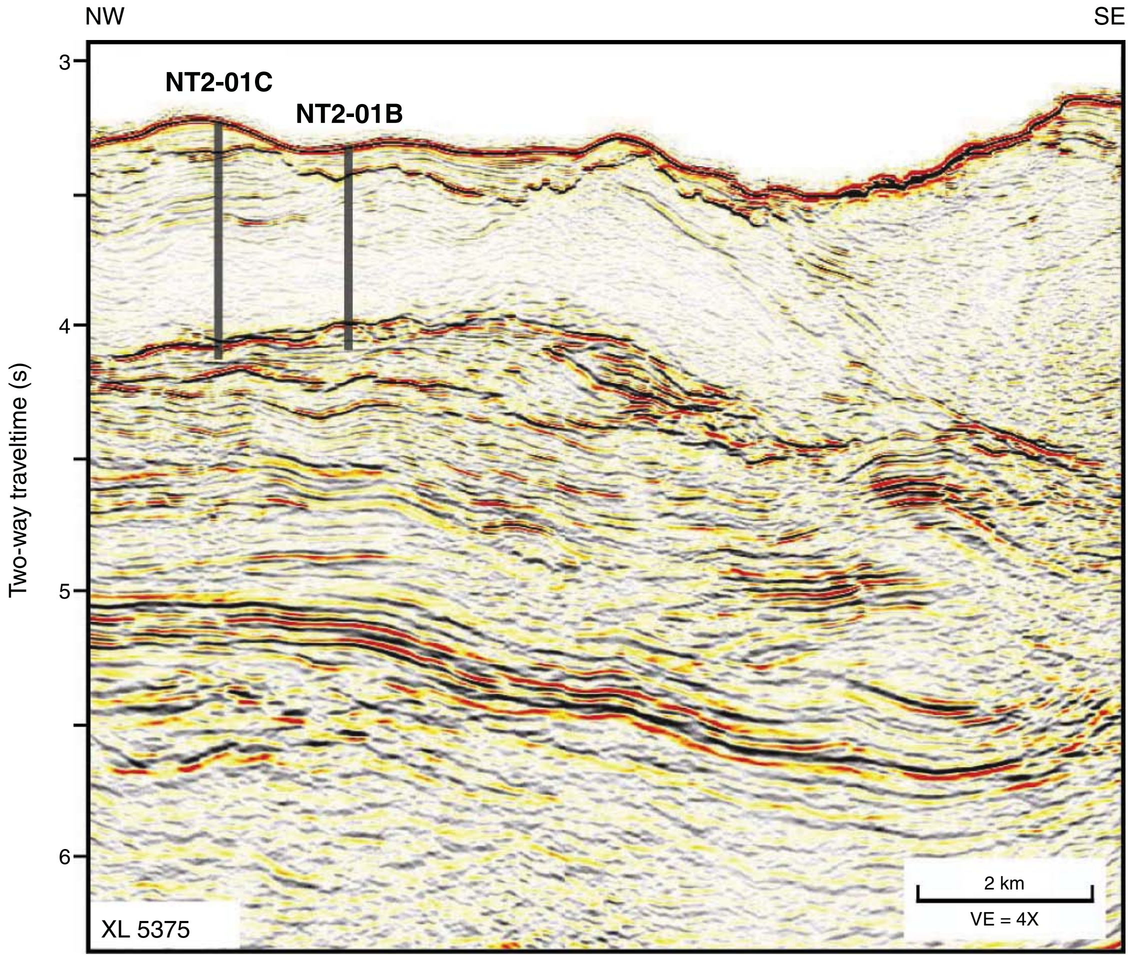


Figure AF27. Inline 2675.

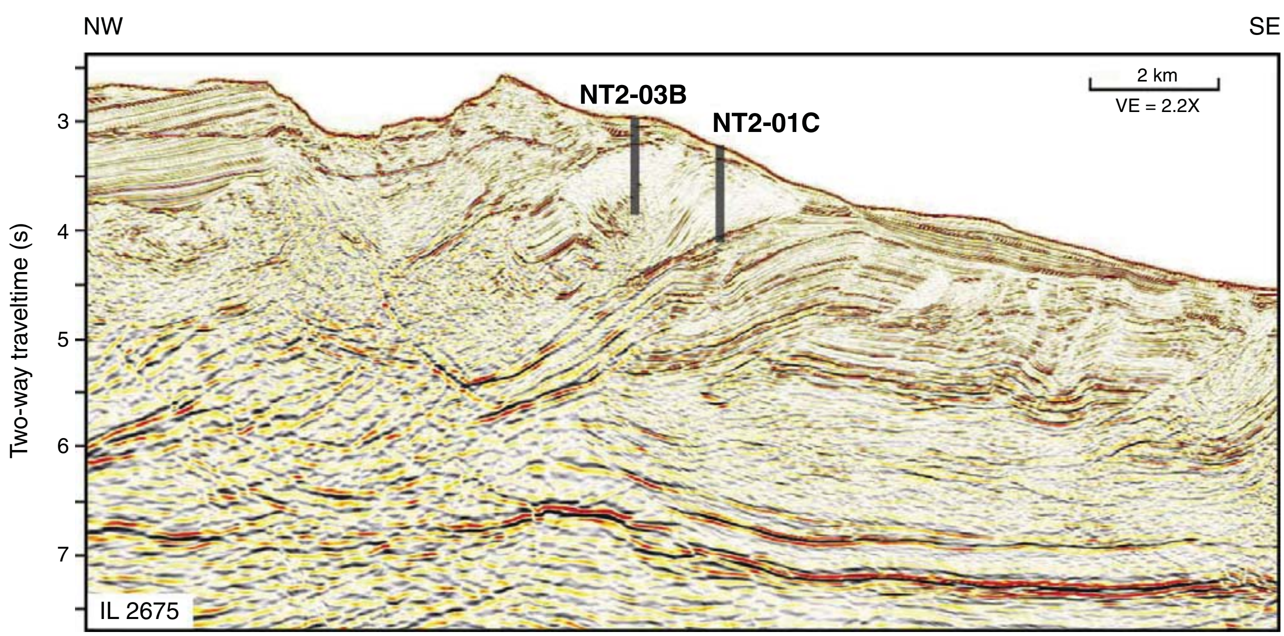


Figure AF28. Inline 2675.

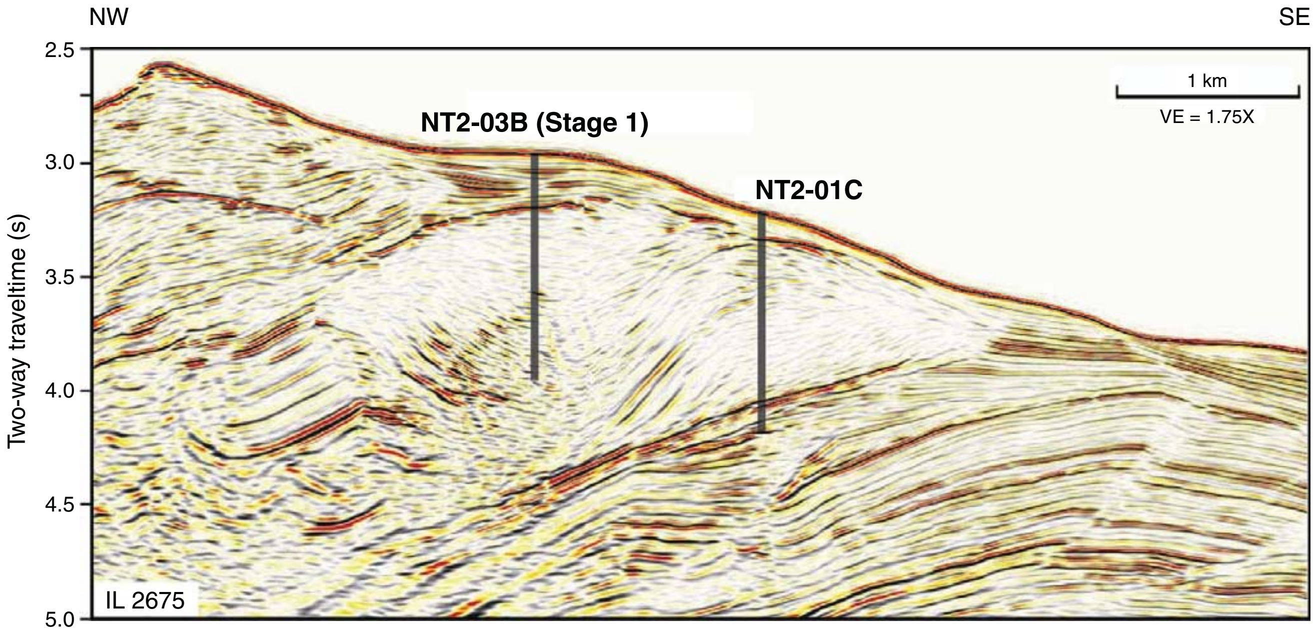


Figure AF29. Crossline 5475.

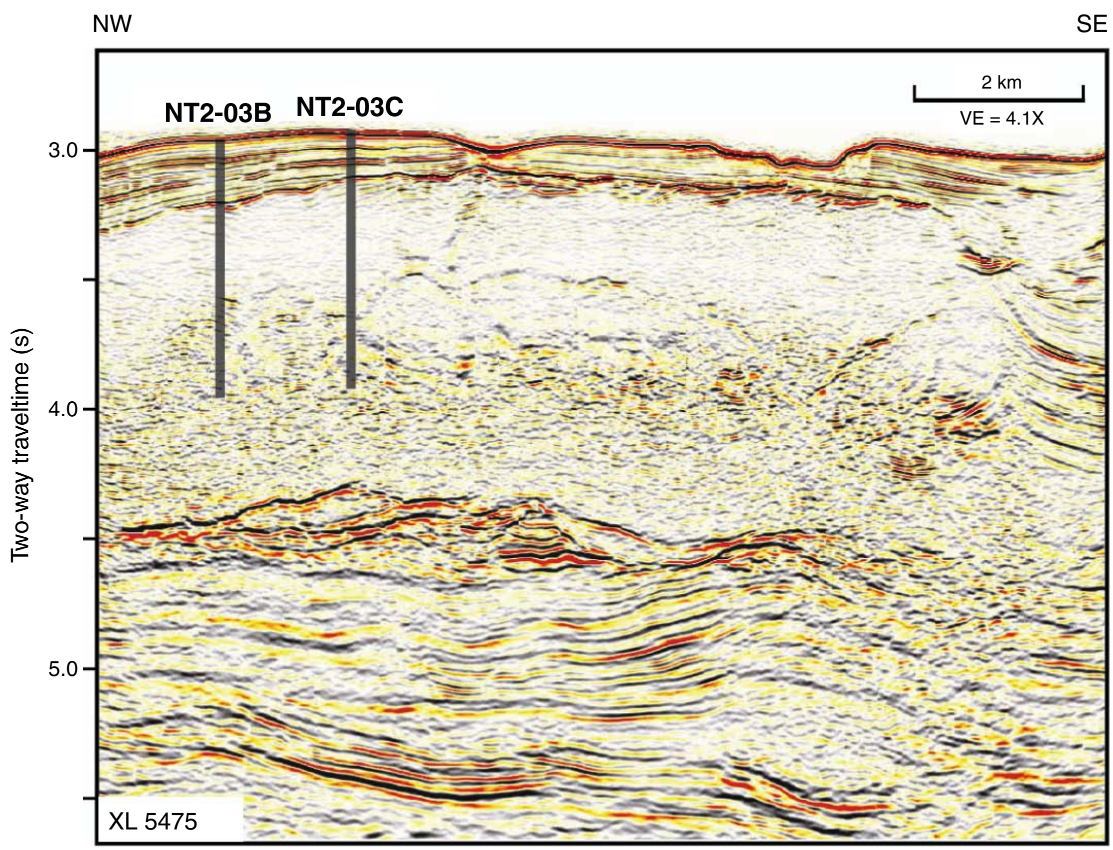


Figure AF30. Track map, Site NT3-01.

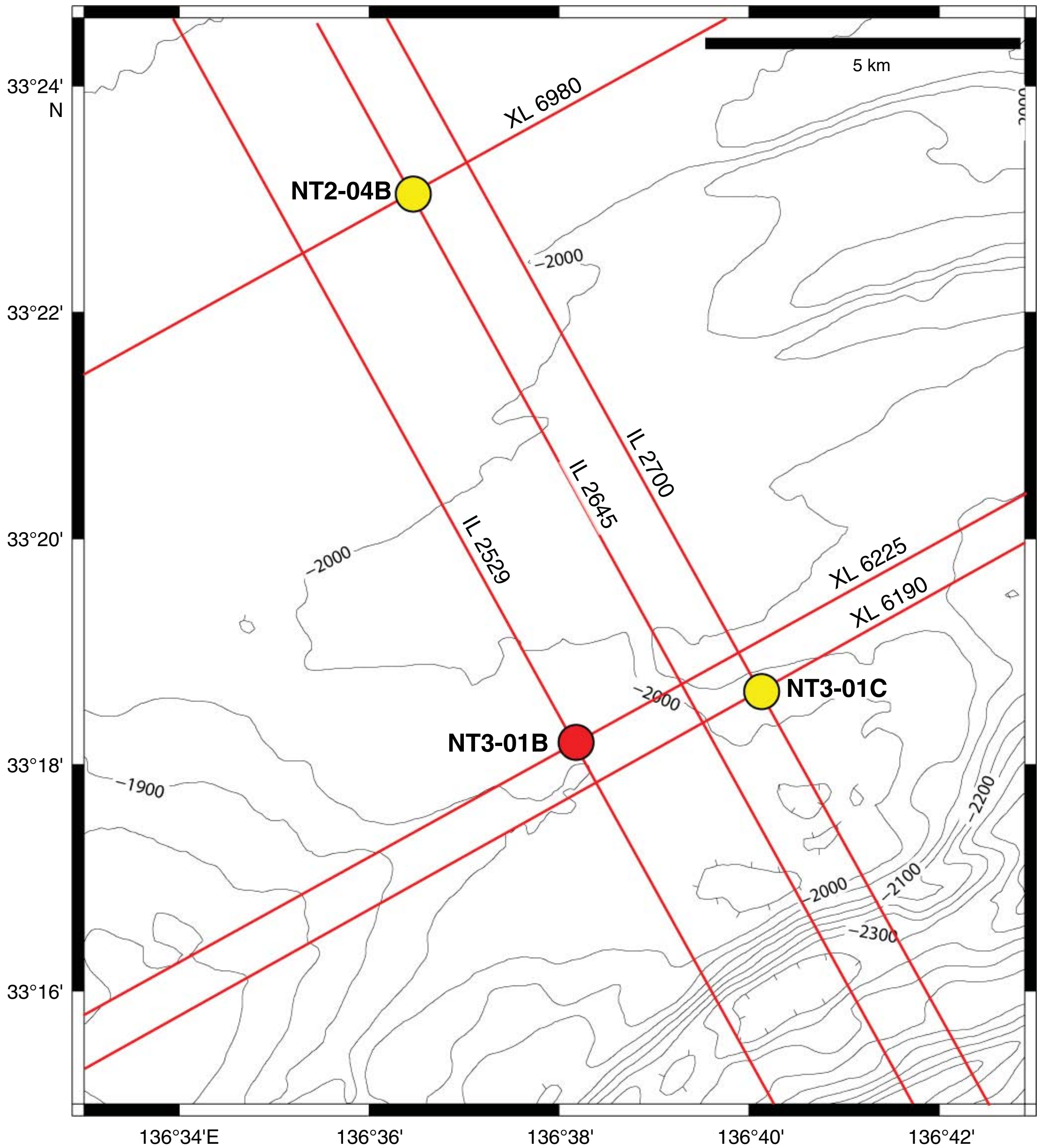


Figure AF31. Inline 2645.

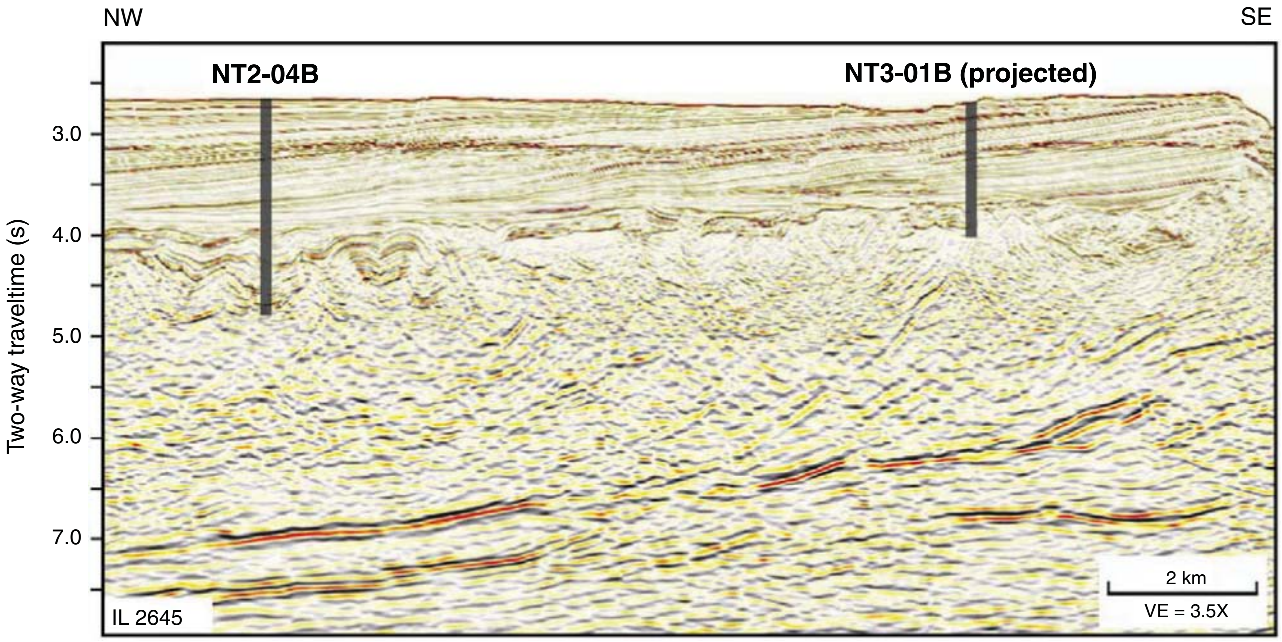


Figure AF32. Inline 2645.

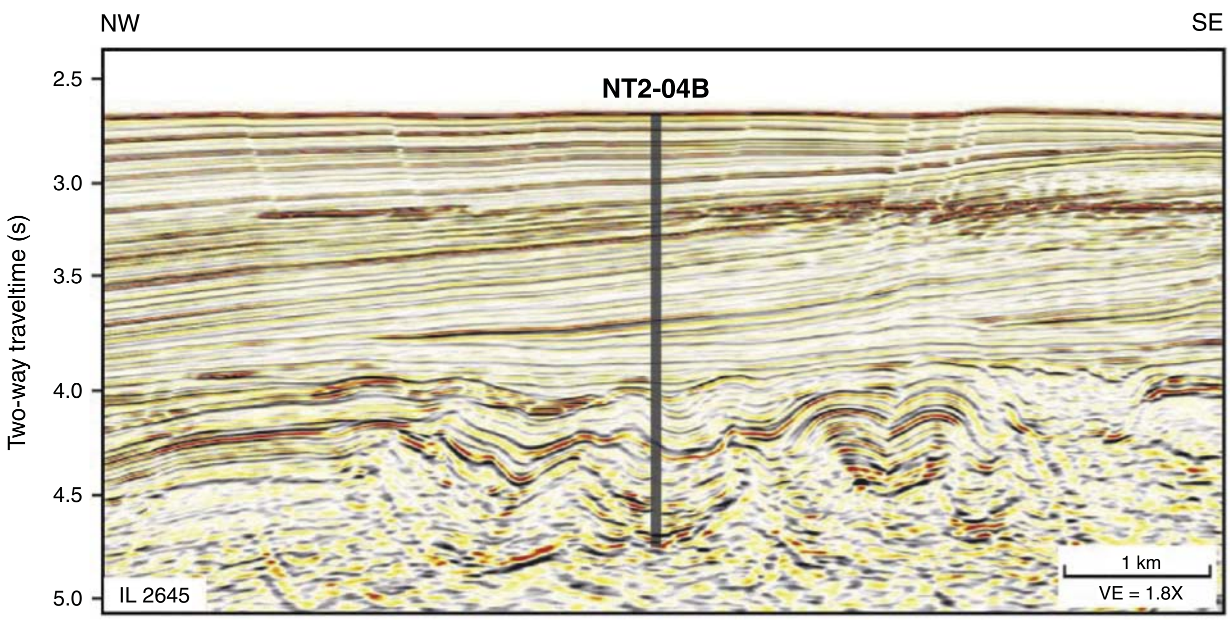


Figure AF33. Crossline 6980.

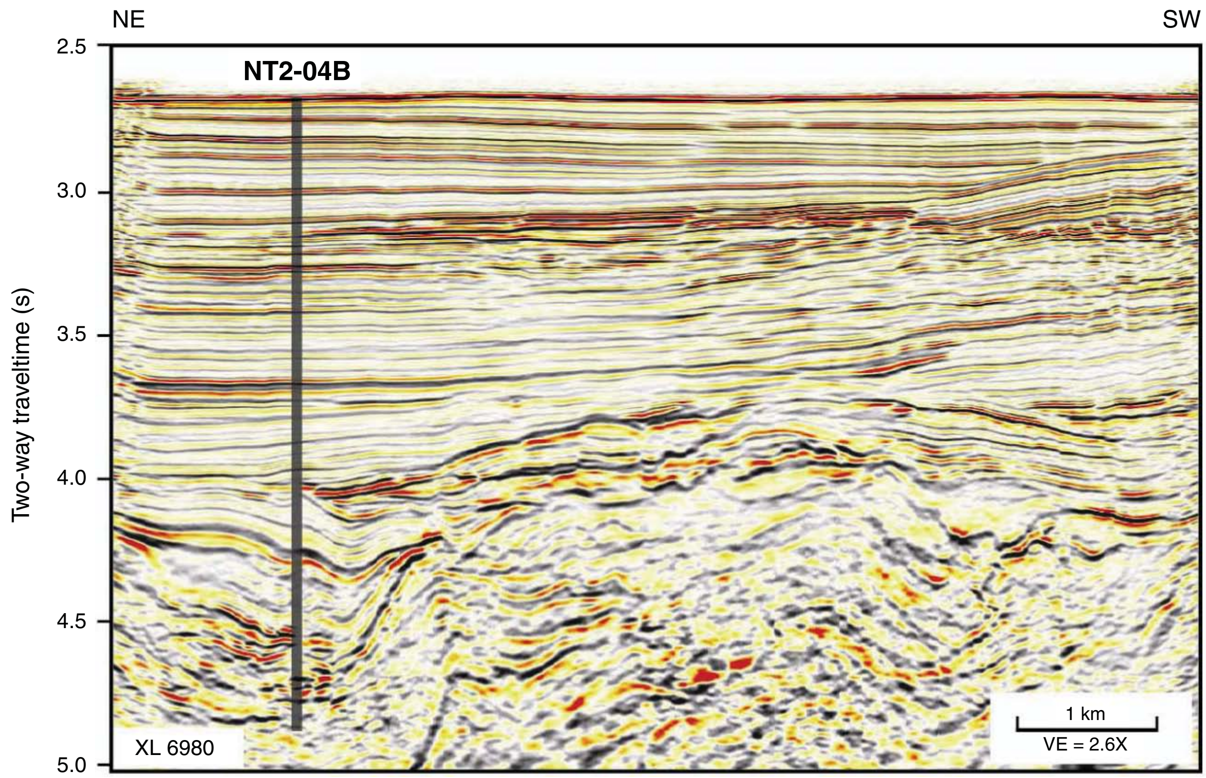


Figure AF34. Inline 2529.

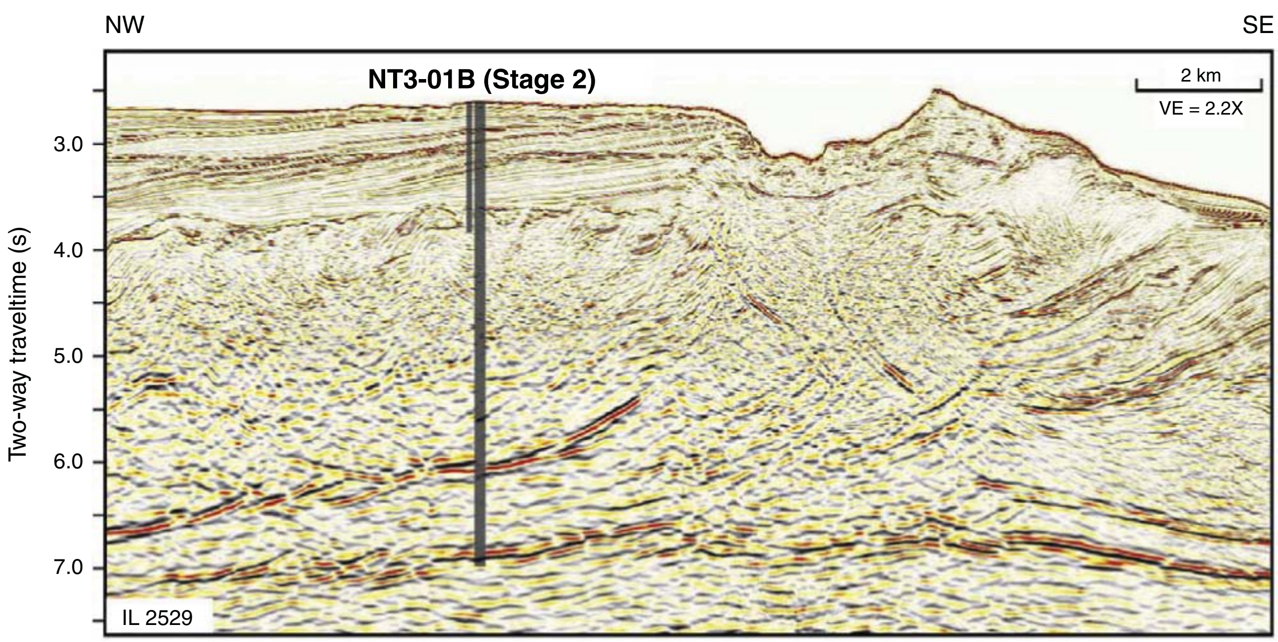


Figure AF35. Inline 2529.

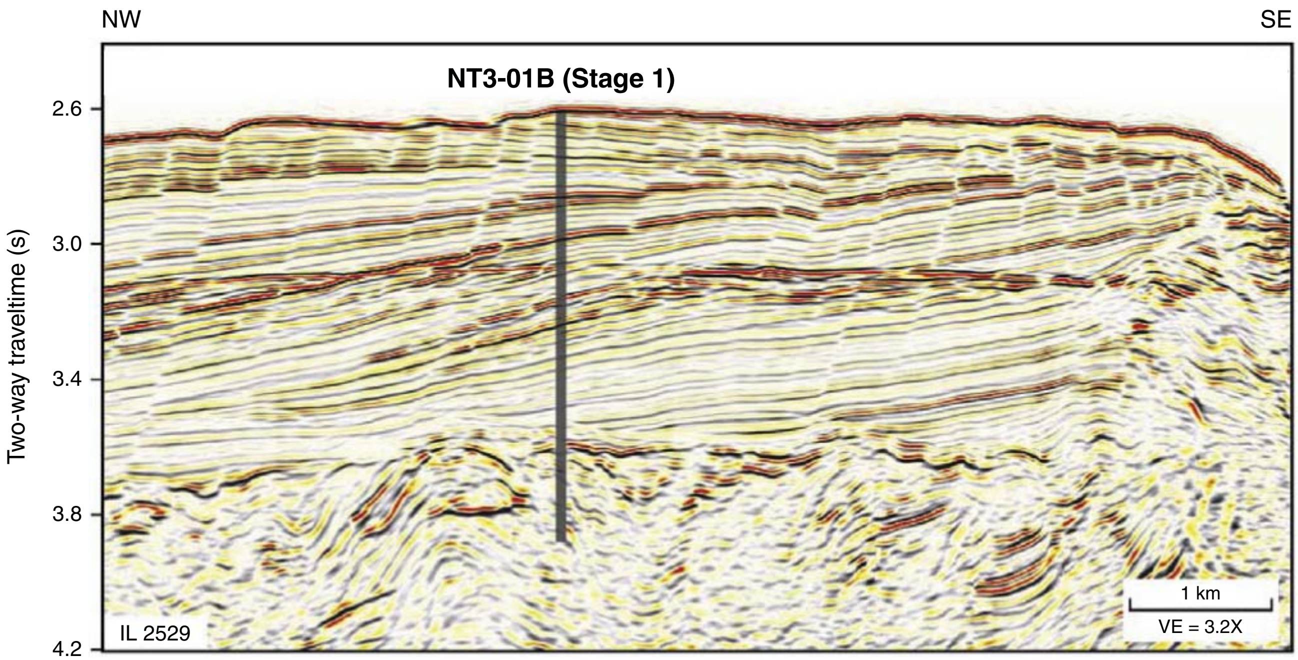


Figure AF36. Crossline 6225.

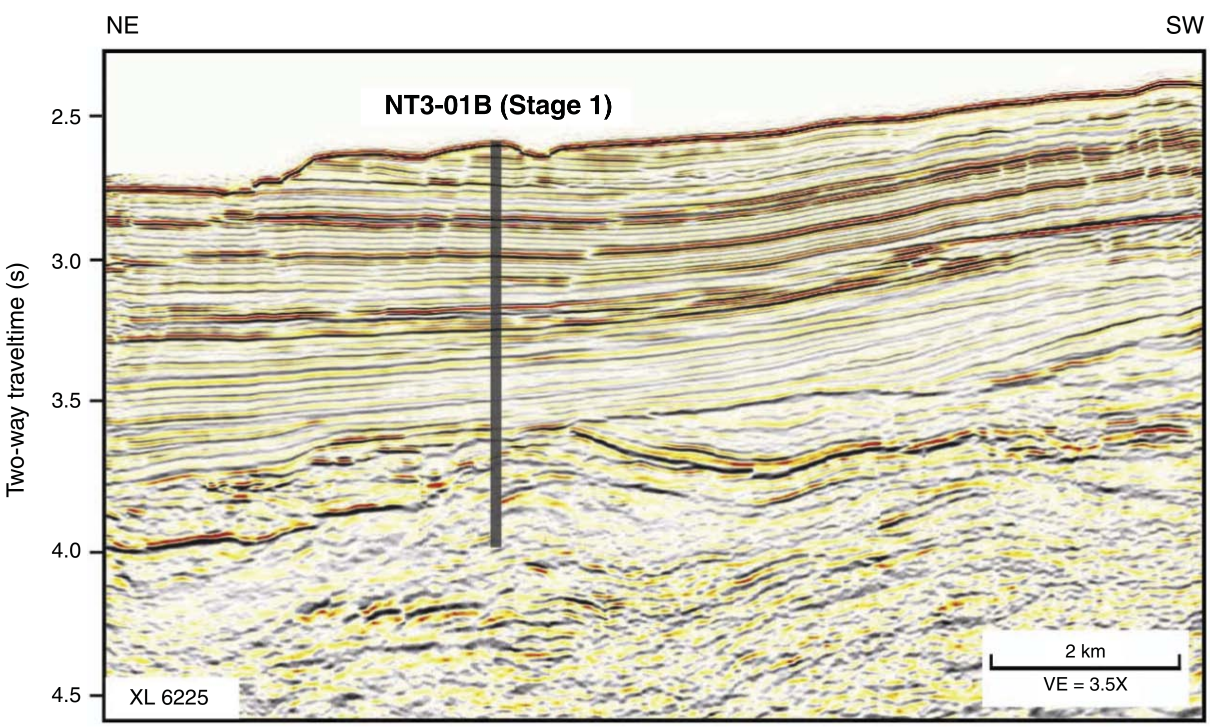


Figure AF37. Inline 2700.

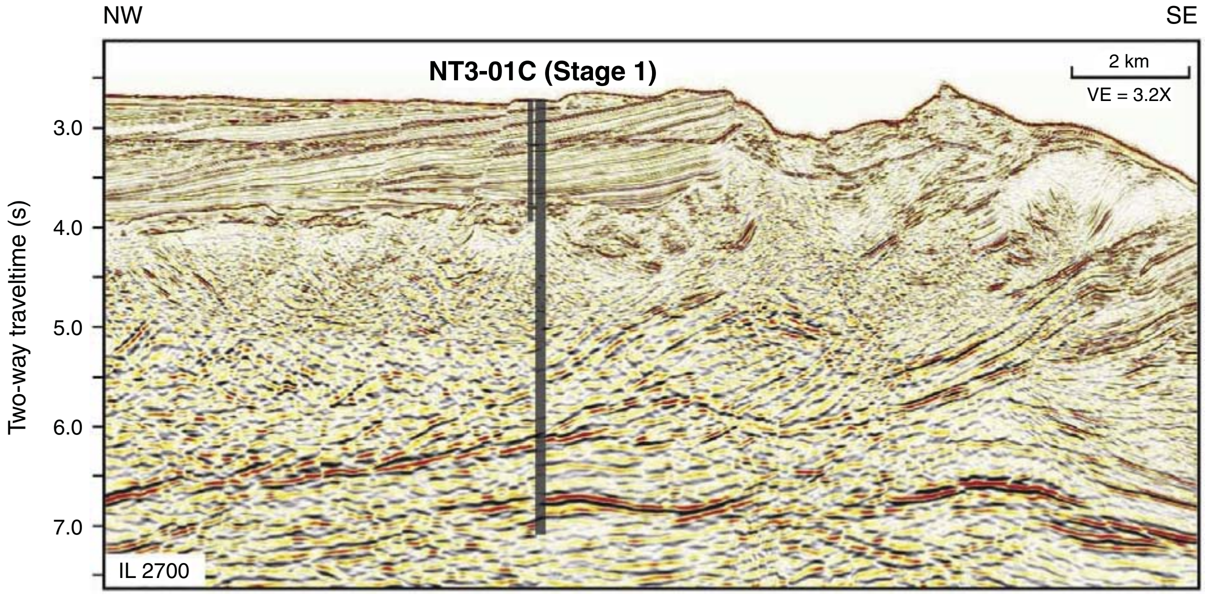


Figure AF38. Inline 2700.

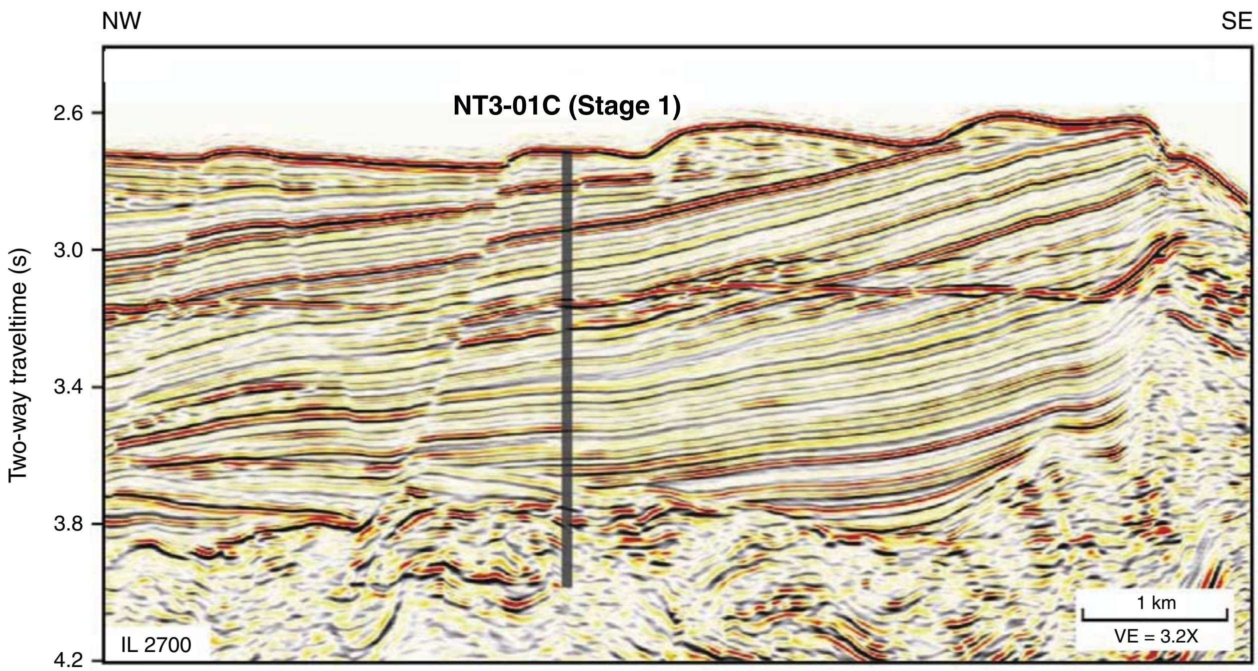
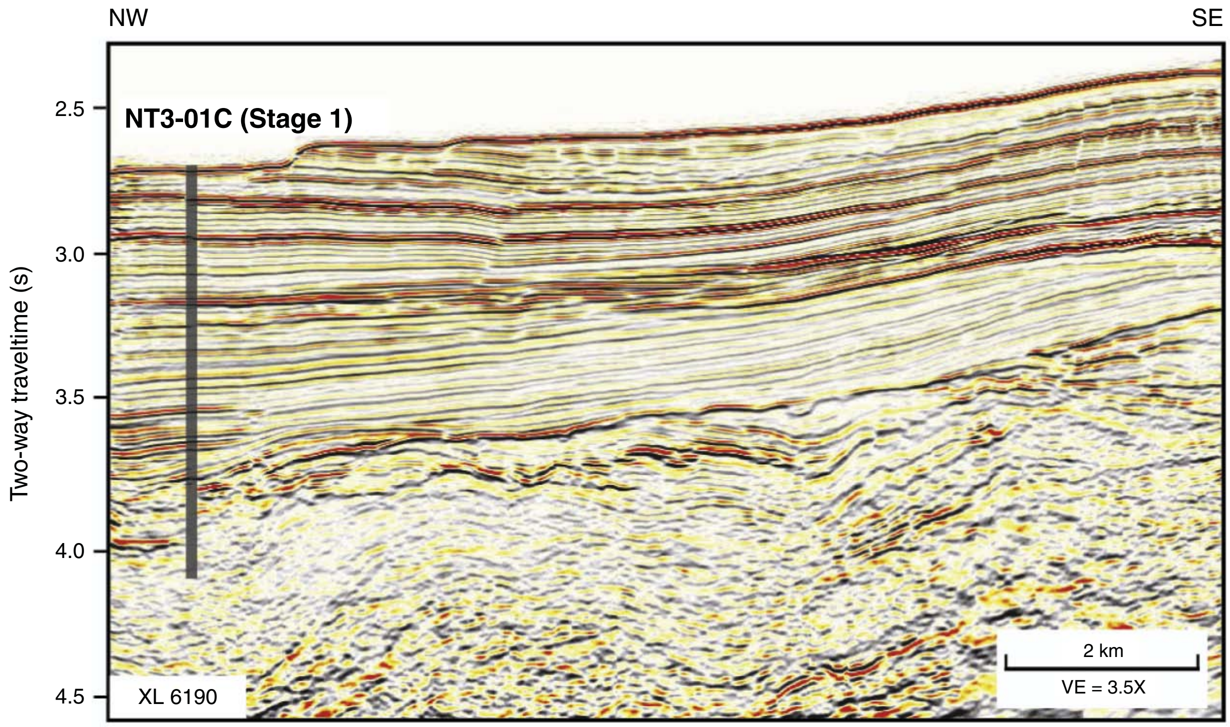


Figure AF39. Crossline 6190.



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