Integrated Ocean Drilling Program Expedition 315 Scientific Prospectus

NanTroSEIZE Stage 1: NanTroSEIZE Megasplay Riser Pilot

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Abstract

Integrated Ocean Drilling Program Expedition 315 is one of three Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) Stage 1 expeditions. The NanTroSEIZE project is a multistage, multiplatform drilling project designed to investigate fault mechanics and seismogenesis along subduction décollement and megathrusts through direct sampling, in situ measurements, and long-term monitoring in conjunction with allied seafloor laboratory and numerical modeling studies. One of the challenging aspects of NanTroSEIZE is the first use of risers in scientific ocean drilling. Expedition 315, entitled "Megasplay Riser Pilot," is a pilot study for the future deep riser drilling of the megasplay fault in Stage 2. The primary engineering and scientific objectives of this expedition are to obtain geotechnical information needed for well planning of future riser drilling to 3500 meters below seafloor. This site's location is also critical for understanding the nature of the shallow portions of splay faults. The scientific targets of this expedition are deformation mechanics, fault-related fluid source and migration pathways, and correlations between fault activity and slump deposits on the trench slope. In this *Scientific Prospectus* we present the scientific background and objectives, the drilling operations designed to achieve them, and contingency plan strategies.

Schedule

Expedition 315 is based on Integrated Ocean Drilling Program (IODP) drilling Proposal 603 (available at **www.iodp.org/NanTroSEIZE**). Following ranking by the IODP Scientific Advisory Structure (SAS), the expedition was assigned to the *Chikyu* operating under contract with the Center for Deep Earth Exploration (CDEX). The expedition is currently scheduled to start 11 November 2007 and end 19 December 2007. A total of 39 days are available for drilling, coring, and downhole measurements as described in this report (the current detailed schedule is available at **www.iodp.org**). Further details on the *Chikyu* are available at **www.jamstec.go.jp/chikyu.**

Introduction

Subduction zones like the Nankai Trough, a region of strong earthquakes (M 8), are especially favorable for study because the entire width (dip extent) of the seismogenic zone ruptures in each great event, so that future rupture areas are perhaps more predictable than for smaller earthquakes (Fig. F1A). The Nankai Trough region is among the best-studied subduction zones in the world. It has a 1300 y historical record of recurring, and typically tsunamigenic, great earthquakes, including the 1944 Tonankai M 8.2 and 1946 Nankaido M 8.3 earthquakes (Ando, 1975; Hori et al., 2004). The rupture area and zone of tsunami generation for the 1944 event are now reasonably well understood (Ichinose et al., 2003; Baba and Cummins, 2005). Land-based geodetic studies suggest that the plate boundary thrust here is strongly locked (Miyazaki and Heki, 2001). Similarly, the relatively low level of microseismicity near the updip limits of the 1940s earthquakes (Obana et al., 2004) implies significant interseismic strain accumulation on the megathrust; however, recent observations of very low frequency (VLF) earthquake event swarms apparently taking place within the accretionary prism in the drilling area (Obara and Ito, 2005) demonstrate that interseismic strain is not confined to slow elastic strain accumulation.

Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) is a multistage, multiyear project. A total of 10 drill sites, including 2 riser drilling sites, are planned (Fig. F1B). During Stage 1 of this project, three expeditions are planned. During Expedition 315, we will drill one site, proposed Site NT2-03, which is the first phase of a two-part strategy. The ultimate objective is to perform riser drilling to ~3500 meters below seafloor (mbsf) during NanTroSEIZE Stage 2, across the megasplay fault at depth, and establish a deep borehole long-term observatory. To achieve the depth objective using riser-based drilling involves setting multiple casing strings, the depth of each depending on the least principal stress, the fracture strength of the formation, and the 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 requires detailed information of the physical properties existing in the uppermost 1000 mbsf. Our strategy, therefore, is to drill and core a riserless pilot hole in this section during Stage 1, and then return for the deeper portion in Stage 2. These pilot studies are essential for well designing for the future planned riser drilling but are also important for science, as described in the following sections. The second half of this expedition may consist of only engineering and operations to set the riser seafloor structure and uppermost casing in preparation for Stage 2 riser operations.

Background geological setting

The Nankai Trough is a plate convergent margin where the Philippine Sea plate subducts to the northwest beneath the Eurasian plate at a rate of ~4.1 cm/y (Seno et al., 1993). The convergence direction is approximately normal to the trench, and sediments of the Shikoku Basin are actively accreting at the deformation front. The Nankai Trough is among the most extensively studied subduction zones in the world, and great earthquakes during the past 3000 y are well documented in historical and archeological records (e.g., Ando, 1975). The Nankai Trough has been selected as a focus site for studies of seismogenesis by both IODP and the U.S. MARGINS initiative, based on the wealth of geological and geophysical data available, the long historical record of great (M > 8.0) earthquakes, and direct societal relevance of understanding the generation and impact of tsunamis and earthquakes on the heavily populated coastal region.

The region offshore the Kii Peninsula has been identified as the best location for seismogenic zone drilling for several reasons. First, the rupture area of the most recent great earthquake, the 1944 Tonankai M 8.2 event, is well constrained by recent seismic and tsunami waveform inversions (e.g., Tanioka and Satake, 2001; Ichinose et al., 2003; Kikuchi et al., 2003). A horizon of significant coseismic slip is reachable by drilling with the *Chikyu*. Second, the region offshore the Kii Peninsula is generally typical of the Nankai margin in terms of heat flow and sediment on the incoming plate, in contrast to the area offshore Cape Muroto where previous Deep Sea Drilling Program (DSDP) and Ocean Drilling Program (ODP) drilling has focused and where both local stratigraphy associated with basement topography and anomalously high heat flow have been documented (Moore, Taira, Klaus, et al., 2001). Third, ocean-bottom seismometer (OBS) campaigns and shore-based high-resolution geodetic studies (though of short duration) indicate significant interseismic strain accumulation (e.g., Miyazaki and Heki, 2001; Obana et al., 2004).

As noted above, a large out-of-sequence thrust (OOST) branches from the master décollement ~50 km landward of the trench along the drilling transect and forms the trenchward boundary of the Kumano Basin (Fig. **F2**). Swath-bathymetric and multichannel seismic (MCS) data show a pronounced, continuous outer ridge of topography extending >120 km along strike, which may be related to the splay fault slip. Remotely operated vehicle (ROV) and submersible surveys along this feature have revealed very steep slopes on either side of the ridge suggesting recent activity (Ashi et al., 2002; Toki et al., 2004). This fault has been termed a "megasplay" and differs markedly from other OOSTs in the following ways:

- It is continuous along strike, is associated with a significant break in the seafloor slope, and is a strong seismic reflector, suggesting that it is a first-order structural element of the margin.

- Significant long-term slip is documented by sequence boundaries and progressive landward tilting of strata in the Kumano Basin is observed in seismic reflection data.
- The megasplay separates rocks with significantly higher seismic velocity on its landward side from rocks of lower seismic velocity toward the trench, suggesting that it represents a major mechanical discontinuity (Nakanishi et al., 2002).
- It is geographically coincident with the updip termination of slip during the 1944 Tonankai M 8.2 event, as inferred from tsunami (Tanioka and Satake, 2001) and seismic (Kikuchi et al., 2003) waveform inversions, and recent structural studies indicate that it may have experienced coseismic slip (e.g., Park et al., 2002).
- Mechanical arguments further suggest that the megasplay is the primary coseismic plate boundary near the updip terminus of slip (e.g., Kame et al., 2003; Wang and Hu, 2006).

Seismic studies/site survey data

A significant volume of site survey data have been collected in the drilling area over many years, including multiple generations of two-dimensional (2-D) seismic reflection (e.g., Park et al., 2002), wide-angle refraction (Nakanishi et al., 2002), passive seismicity (e.g., Obana et al., 2004), heat flow (Kinoshita et al., 2003), side-scan sonar, and swath bathymetry. In 2006, Japan and the United States conducted a joint, three-dimensional (3-D) seismic reflection survey over a ~11 km × 55 km area, acquired by PGS Geophysical, an industry service company. This 3-D data volume, the first deep-penetration, fully 3-D marine survey ever acquired for basic research purposes, is being used to refine selection of drill sites and targets in the complex megasplay fault region, to define the regional structure and seismic stratigraphy, 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.

Since 2001, *Shinkai 6500* dives have revealed a general distribution of cold seeps, pore fluid chemistries of surface sediments, thermal structure, and geological structures. Cold seeps are distributed at active faults on the prism slope (Ashi et al., 2002; Toki et al., 2004) and mud volcanoes in the Kumano Basin (Kuramoto et al., 2001). The densest chemosynthetic biological communities are observed along the fault scarp base of the megasplay 30 km southwest of proposed Site NT2-03B. This cold seep is characterized by high heat flow based on 1 y of monitoring (Goto et al., 2003) and low chlorinity of pore fluid chemistry (Toki et al., 2004), suggesting updip migration of fluids probably through the fault zone from the deep prism. Seafloor observations were also conducted near proposed Site NT2-03B using the submersible *Shinkai 6500*, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deep-tow video camera *4K*, and the ROV *Kaiko*. The gentle slope around proposed Site NT2-03B is completely covered by hemipelagic sediment and shows no indications of any cold seep activity. In contrast to the southern slope of the outer ridge, which was formed by recurrent slips of the splay fault system, bacterial mats and a carbonate chimney were observed on the landward flank of the outer ridge (Toki et al., 2004). A northeast–southwest elongated depression has developed between the outer ridge and the forearc basin. The deep-towed side-scan sonar system *Wadatsumi* revealed a strong north-northeast–south-southwest lineament on the basin floor of the depression and a swarm of normal faults at the southern margin of the forearc basin (Fig. **F3**). Bacterial mats, tubeworms, and carbonate crusts were also observed on the landward slopes of the depression where the forearc basin strata are partly exposed (Fig. **F3**). 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

1. *Acquisition of geotechnical data and establishment of core-log-seismic integration for deep riser drilling.*

Proposed Site NT2-03B will target the main splay at an ultimate depth of ~3500 mbsf during Stage 2. Stage 1 drilling is a pilot hole with a total depth of 1000 mbsf for riser drilling planned in Stage 2. The expected lithologies are young slope sediments (hemipelagites and slump deposits) in the upper section and old accreted trench sediments in the underlying section. We will not penetrate the underlying thrust during Stage 1, but this hole will be deepened during the riser drilling stage to the megasplay fault penetrated at proposed Site NT2-01. Acquisition of core and logging data (by logging while drilling [LWD] during Expedition 314) and their integration in this pilot hole is not only geotechnically but also scientifically important. In future riser drilling, whole-core recovery is not necessarily guaranteed for two reasons. First, some less scientifically important intervals might be skipped in the interest of saving time. Second, even if we try to recover the whole core, recovery may be poor in some sections, especially in highly fractured lithologies. To compensate for incomplete core information, wireline logging and mud logging should be utilized as much as possible to understand lithologic, stratigraphic, geophysical, and geochemical properties of the downhole formations. Therefore, it is of primary importance to establish a complete correlation between the core, logging, and seismic data in this pilot hole, as was done during the German Continental Deep Drilling Program (KTB), which produced highly successful results (Emmermann and Lauterjung, 1997).

Temperature measurement also provides important information on estimating the geothermal gradient to 3500 mbsf, which is essential for designing the long-term monitoring observatory.

2. *Structural investigations of strain partitioning between the prism and the forearc basin in oblique subduction.*

Defining the upper limit of a splay thrust

As stated above, the recent 3-D seismic survey showed that the splay fault system originally defined on 2-D seismic lines (e.g., Park et al., 2002) was actually composed of two main fault systems referred to as the upper splay fault (USF) and the lower splay fault (LSF), locally associated with prominent reflectors (Fig. **F4**). Proposed Site NT2-03B for drilling the lower splay fault system at intermediate depth (3500 mbsf) during Stage 2 was chosen in a location ~2 km seaward of the outer ridge crest. This site has been chosen primarily to simultaneously meet two requirements that are difficult to find together: (1) a small slope angle to the seabed and (2) significant amplitude in the deep splay fault reflector. These requirements have been found in a small (1 km wide) bench on the seaward slope of the crest corresponding to a ~200 m thick series of layered reflectors, which may partly correspond to a slope basin (Fig. **F5**). The USF system does not seem to outcrop here, and we can question whether it is presently inactive or simply a blind thrust. To understand the development of this complex wedge-shaped basin is key to answering this question. The boundary between the basin and the underlying and locally transparent unit (probably deformed turbiditic sequences) appears in this part of the 3-D box as a high-amplitude reflector with normal polarity at 210 mbsf. The meaning of this reflector is one of the most interesting problems we have to solve during Expedition 315. Is it (1) a simple sedimentary unconformity between the slope basin and the underlying deformed accretionary sediments in front of a blind splay thrust or (2) the updip extension of the upper splay fault? In the first case, the propagation of the deformation related to the USF stops landward of proposed Site NT2-03B (Fig. **F6A**), whereas in the latter case, the deformation propagates on a detachment surface along, or more probably close, to the basal unconformity (Fig. **F6B**). At the location of proposed Site NT2-03B, a faint landward-dipping reflector cutting the basin reflectors can be interpreted as a thrust, although we cannot completely rule it out as a sedimentary feature. Such a thrust could be the updip extension of the USF covered with only a very thin gliding unit (Fig. **F6C**). Defining the updip extension of the USF and thus choosing between these different working hypotheses is one of the major structural goals of drilling at proposed Site NT2-03B during Stage 1.

Strain partitioning between the active accretionary wedge and the forearc basin domain

The seafloor morphology of the outer ridge domain in the Kumano transect shows numerous linear features. This strongly suggests that it is a strike-slip component of the deformation, which can be interpreted as a strain partitioning of the oblique convergent motion with right-lateral motion mostly expressed along the wedge/forearc boundary. Similar partitioning has been described within the forearc basin of the neighboring Tokai domain (Huchon et al., 1998). Although the main linear depression located landward of the outer ridge might be partly due to erosional processes, it seems to be structurally controlled as shown by a sharp linear scarp seen on the *Wadatsumi* side-scan sonar images (Fig. **F7**) and is probably due to the development of a pull-apart basin (Fig. **F8**). Although the strike-slip component seems to be concentrated mostly on the landward side of the outer ridge, we shall carefully check the core-scale structures at proposed Site NT2-03B for indications of such a strike-slip deformation.

Extensional versus compressive deformation

The Kumano Basin's seaward edge is cut by normal faults whose spacing rapidly decreases toward the outer ridge depression. On the other hand, some minor normal faults can be observed locally just seaward of the LSF (Fig. **F9**). In a working hypothesis that the splay fault moves rapidly during the coseismic period, these features could be related to gravity relaxation of the outer ridge domain during the interseismic period. Observation of such extensional features in a core scale during Stage 1 drilling, as well as their mutual relationships with the compressional structures, would be of primary interest in understanding the deformation cycle of a splay fault system.

3. *Geochemical investigations of migrating fluids through splay faults.*

Geochemistry of pore fluids reflects conditions of the deep prism where structural deformations, diagenesis, and metamorphism occur. Active cold seeps, with bacterial mats and clam colonies, have been observed at the scarp base of the megasplay 30 km southwest of proposed Site NT2-03B during submersible dives (Fig. **F3**) (Ashi et al., 2002). Pore fluids of the surface sediments are characterized by low chlorinity, low δD, and low $\delta^{18}O$ (Toki et al., 2004). These geochemical and isotopic features prefer land-derived groundwater for their origin; however, it is hard to explain the hydrological connection between land and the seep site 70 km offshore (Fig. **F1B**). Seafloor observations with ROV and deep-towed video cameras near proposed Site NT2-03B have revealed thick hemipelagic cover and no evidence for cold seepage (Fig. **F3**). In shallow cover sediments, diffusion is the dominant mode of upward migration of fluids; however, in the deeper part, channel flow through fault zones and/or fractures may be the dominant mode of fluid migration rather than diffusion with decreasing permeability. Determining the migrating path of fluids, therefore, is of primary importance. We will penetrate the probable USF at a shallow depth, and we expect to obtain pristine fluids by drilling both from the fault zone and the over/underlying sediments with much less contamination from seawater than sampling at the seafloor. Their chemistries will provide valuable information regarding their origins and migrating paths. Integration with the fluid chemistries around the LSF and its hanging wall, to be drilled at proposed Site NT2-01B during IODP Expedition 316 (Fig. **F4**), will help further our understanding of fluid migration.

In contrast to the unidentified source of low-chlorinity fluids mentioned above, hydrocarbon analyses indicate a light carbon isotopic composition from dissolved methane and a low C_2H_6/CH_4 ratio, suggesting a biological origin for the methane (Toki et al., 2004). We are also interested in understanding the relationships between formation and migration of methane and sediment deformations. Formation and dissociation of gas hydrate probably affect methane circulation, although a bottom-simulating reflector (BSR) has not been identified near proposed Site NT2-03B.

4. *Reconstruction of the prism and the forearc basin evolution based on stratigraphic records.*

Surface strata at proposed Site NT2-03 are expected to consist of reworked sediments and hemipelagite. A piston core sample taken from the base of the fault scarp 30 km southwest of proposed Site NT2-03B included more than 10 debris layers intercalated with hemipelagic sediments, suggesting repeated falling or sliding at the time of fault displacement and/or nearby earthquake. The recurrence time of probable event depositions is estimated to be ~1000 y between 15 and 27 ka based on carbon isotope ages of foraminifer fossils (Ikehara, unpubl. data, 2006). A similar sedimentary sequence is expected in the shallow part of proposed Site NT2-03B (Fig. **F4**) that provides longer records of recent activities of the megasplay faults.

Old accreted sedimentary sequences are expected beneath the 210 mbsf boundary. This unit is characterized by transparent acoustic features in 3-D seismic profiles that suggest the presence of highly dipping bedding reflectors and/or highly disrupted sequences (Fig. **F4**). Microfossil age determinations, thermal histories from clay diagenesis, and fluid inclusion thermobarometries in quartz and calcite veins could provide information about the growth and exhumation of the accretionary prisms. Proposed Site NT2-01B, 2 km south of proposed Site NT2-03B, is planned to penetrate the LSF. Evolution of the megasplay fault zone associated with prism growth will be revealed by integration and comparison of data from both sites.

Drilling strategy

Continuous coring in the splay fault drilling at proposed Site NT2-03B (and its alternate proposed Site NT2-03C) are essential for characterizing the composition, structure, and architecture of the fault zones and wall rocks. Chemical composition, diagenetic processes, microstructures, and potential sealing/healing processes will be examined in the active splay fault zone and wall rocks. Physical property data, including porosity, electrical resistivity, and seismic velocity, are key parameters in assessing the mechanical and hydrologic behavior of fault and wall rocks. Whole-round and discrete core sampling are necessary for postexpedition studies such as permeability and consolidation experiments and mechanical (rock friction) tests. Pore fluid chemistry data will be important toward constraining the hydrologic behavior of the megasplay faults and the source of any chemically and/or isotopically distinct, deeply sourced fluids.

We will drill three holes during Expedition 315. Hole B is for coring only (Hole A is a LWD hole drilled during IODP Expedition 314). We will start drilling with the hydraulic piston coring system (HPCS) to refusal and continue with the extension shoe coring system (ESCS) to 600 mbsf. Hole C is for coring. We will drill out the upper 600 m and core with a rotary core barrel (RCB) to total depth (1000 mbsf) (Fig. **F10**). Expected lithologies are hemipelagite and slump deposits for the upper ~210 m section and well-consolidated and highly deformed sediments in the underlying accretionary prism section. We may also encounter fault rocks that are cataclastically deformed to various extents. Since we may encounter caving problems in these sections, we will use bentonite mud, if necessary. We will also prepare weighted kill-mud for potential overpressure beneath the upper slump sediments.

After coring and logging in Holes B and C, we will drill and case the upper 700 m of the future riser hole (Hole D). We will jet-in a 36 inch conductor pipe to 60 mbsf and drill a 26 inch hole to 700 m in riserless mode. Then we will set a 20 inch casing and place a wellhead and corrosion cap to suspend the well for the future riser drilling. Basically, no scientific operation is planned during Hole D drilling; however, if the coring in Hole B is unsuccessful, we will collect the core from this hole. The drilling schedule is shown in Figure **F11** and Table **T1**.

Logging/downhole measurements strategy

Because Expedition 314 will conduct LWD operations at the same site, we will have no wireline logging program on our expedition as long as the previous expedition is successful. In the case that the Expedition 314 LWD operations are unsuccessful, there are two options. If the failure on the LWD expedition is due to other than hole conditions (e.g., mechanical problems, weather conditions, time limitations, etc.), we will run a full set of wireline logging with three runs on this expedition: triple combination (natural gamma radiation, density, neutron porosity, and electrical resistivity) in the first run; oriented electric resistivity imaging, natural gamma radiation, and sonic velocities on the second run; and vertical seismic profile (VSP) on the third run. On the other hand, if the reason for unsuccessful LWD operations is due to bad hole conditions, wireline logging is expected to be less successful. In past DSDP and ODP accretionary prism drilling, wireline logging was not completely successful; therefore, we will not run any wireline logging in case of poor hole conditions. The final decision regarding the wireline logging menu will be made immediately after LWD Expedition 314.

Estimating the geothermal gradient is one of the key issues for future deep riser drilling. Downhole measurement tools (third-generation advanced piston corer temperature [APCT-3] tool and Davis-Villinger Temperature Probe [DVTP]) will be used to measure formation temperature. The APCT tool is used every 30 m for HPCS coring intervals, and the DVTP is used every 50 m for ESCS coring intervals. Tool details can be found online at **iodp.tamu.edu/tools/specs.html#dow**.

Contingency

There are two levels of contingency: internal and global. The internal contingency is an alternative operation/science plan inside proposed Site NT2-03. Global contingency refers to a more general alternative plan among all Stage 1 sites. In case we cannot proceed with operations at the primary site (proposed Site NT2-03B), we will first try the internal contingency. If this also turns out to be impossible, we will then follow the global contingency plan.

Internal contingency

If the primary site cannot be drilled because of seafloor conditions or other local problems, we will move to the alternate proposed Site NT2-03C. Proposed Site NT2-03C is ~1.5 km southwest of proposed Site NT2-03B along the same 3-D crossline and on the same inline as proposed Site NT2-01B (Fig. **F12**). All objectives and geologic characteristics are the same as for proposed Site NT2-03B.

Global contingency

If major hole problems are found for both proposed Sites NT2-03B and NT2-03C during the LWD expedition (Expedition 314), or if a strong Kuroshio Current crosses the sites, the alternative sites listed below will be prepared. This contingency plan is based upon our current state of knowledge at the time of writing this *Scientific Prospectus* and may be modified based on continuing NanTroSEIZE Project Management Team (NT-PMT) discussions and actual NanTroSEIZE Stage 1 operations. This contingency plan also reflects the linkage among multiple NanTroSEIZE Stage 1 expeditions to achieve the following overarching NanTroSEIZE and Stage 1 scientific goals:

- Coring at proposed Site NT2-04. This site will penetrate 1400 m of the Kumano Basin sequences to clarify its stratigraphic evolution in correlation with the activities of the megasplay fault.
- Drilling and coring at proposed Site NT1-04. This site will provide additional information about physical properties, pore water geochemistry, and hydrogeology of turbidites within the Shikoku Basin beneath rapidly deposited trench-wedge turbidites at a site between proposed Sites NT1-03 and NT1-07.
- Drilling and coring at proposed Site NT1-02. This site will document subduction inputs at a site along strike from proposed Site NT1-01 to document along-strike variability.

Sampling and data sharing strategy

NanTroSEIZE Stage 1 expeditions are a single coordinated science program

To maximize the science return, the three 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 three 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 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, Expedition Project Manager, 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 sampling and 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 Stage 1 expeditions, as well as the overarching Stage 1 *Scientific Prospectus* (Tobin and Kinoshita, 2006).

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.

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Table T1. Operations plan and time estimate for proposed Site NT2-03, Expedition 315. (Continued on next page.)

Hole	PTD (mbsf)	Water depth (m)	Total (mbsl)	Operations	Estimated days	Number of cores
B	600	2178	2778	Prepare for drilling (guidehorn, BHA, etc.)	1.0	
				RIH HPCS/ESCS assembly	0.5	
				Core with HPCS and ESCS to 600 m	5.5	64
				Carry out jet-in test before coring and start coring at new hole - Try to take core by HPCS and ESCS to PTD; if PTD cannot be reached, go to Hole C - Require core orientation - Hole size: 11-7/16 inch - Temperature measurement every 50 m by APCT-3 or DVTP		
				POOH, lay out HPCS/ESCS assembly	0.5	
				Total drilling days:	7.5	
Hole B remarks: - No retrieving guidehorn - Penetration rate 120 m/day - HPCS/ESCS 9.5 m/bbl - Pump weighted mud into hole before POOH (abandonment) - May encounter thousands of faults and deformed sequences						
C	1000	2178	3428	Move to Hole C, RIH RCB assembly	0.5	
				Drill to 600 m by RCB	1.5	
				If Hole B cannot reach PTD, start to take core from refusal depth of Hole B - Limit daily progress to 400 m/day to maintain good hole - Hole size: 9-7/8 inch - Core with RCB to 1000 m	6.5	69
				Take 650 m core by RCB - Take overlapping core of Hole B - Wiper trip	0.5	
				Displace with weighted mud, drop bit, POOH to seafloor	0.5	
				POOH, lay out RCB assembly	0.5	
				Retrieve guidehorn	0.5	
				Total drilling days:	10.5	
Hole C remarks: - RCB 9.5 m/bbl - If core does not go to 700 m, consider coring at riser hole						
				Expedition 315 total drilling days:	18.0	
				Transit between base and location:	0.0	
				Equipment and fuel supply before expedition:	0.0	
				Total operation days (without contingency):	18.0	
				Contingency:	4.0	
				Expedition 315 total operation days:	22.0	

Table T1 (continued).

Hole	PTD (mbsf)	Water depth (m)	Total (mbsl)	Operations	Estimated days	Number of cores
Riser	700	2178	2878	Prepare for running BHA and 36 inch conductor	0.5	
				Run and jet-in 36 inch conductor to 60 m - Conductor setting depth will be decided by result of jet-in test	1.5	
				Drill 26 inch hole to 700 m - Set guidehorn	2.0	
				Run and cement 20 inch casing	3.0	
				POOH, lay out BHA	1.0	
				Total drilling days:	8.0	
Riser hole remarks: - No retrieving guidehorn						
				Expedition 315 riser total drilling days:	8.0	
				Transit between base and location:	0.0	
				Equipment and fuel supply before expedition:	0.0	
				Total operation days (without contingency):	8.0	
				Contingency:	5.0	
				Expedition 315 riser total operation days:	13.0	

Notes: PTD = proposed total depth, BHA = bottom-hole assembly, RIH = run in hole, HPCS = hydraulic piston coring system, ESCS = extension shoe coring system, POOH = pull out of hole, DVTP = Davis-Villinger Temperature Probe, APCT-3 = third-generation advanced piston corer temperature tool, RCB = rotary core barrel.

Figure F1. A. The Nankai Trough off southwestern Japan is the locus of subduction of the Philippine Sea plate (PSP) beneath Honshu and Shikoku islands. Yellow arrow = convergence direction of PSP and Japan. This regional bathymetric map shows the rupture zones of the last two great subduction earthquakes (1944, 1946). Stars = epicenter locations for earthquake nucleation. Red outline = location of NanTroSEIZE drilling area. Inset shows the location of the Nankai Trough. EP = Eurasian plate, PP = Pacific plate, NAP = North American plate. (Continued on next page.)

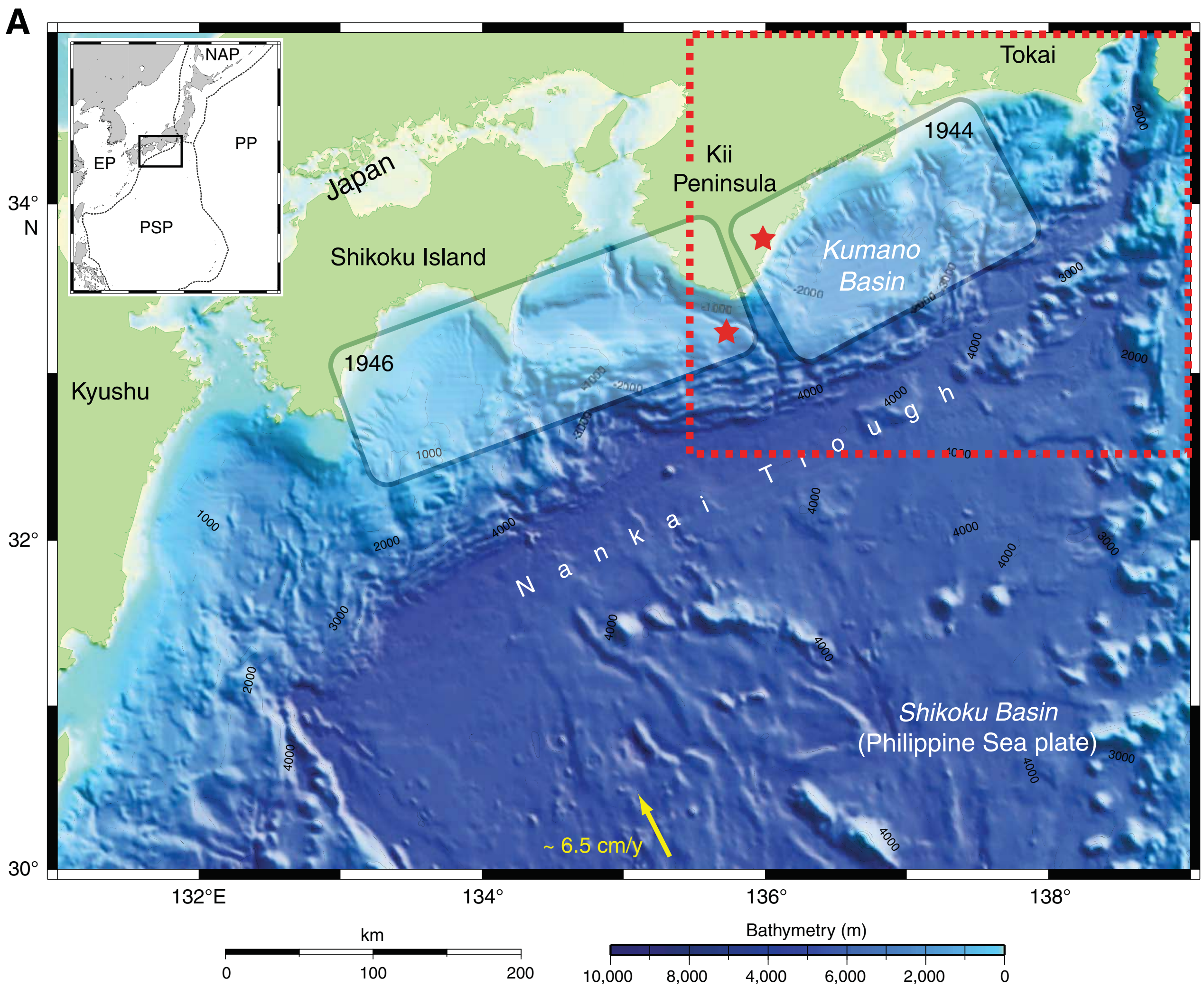


Figure F1 (continued). B. Map of Kumano Basin region with planned Stage 1 drill sites. Red dots = proposed primary sites, green dots = proposed alternate sites, black outline = location of 2006 three-dimensional seismic survey, thick black line = KR0108-5 two-dimensional seismic surveys, portions of which are shown in Figure **F2.**

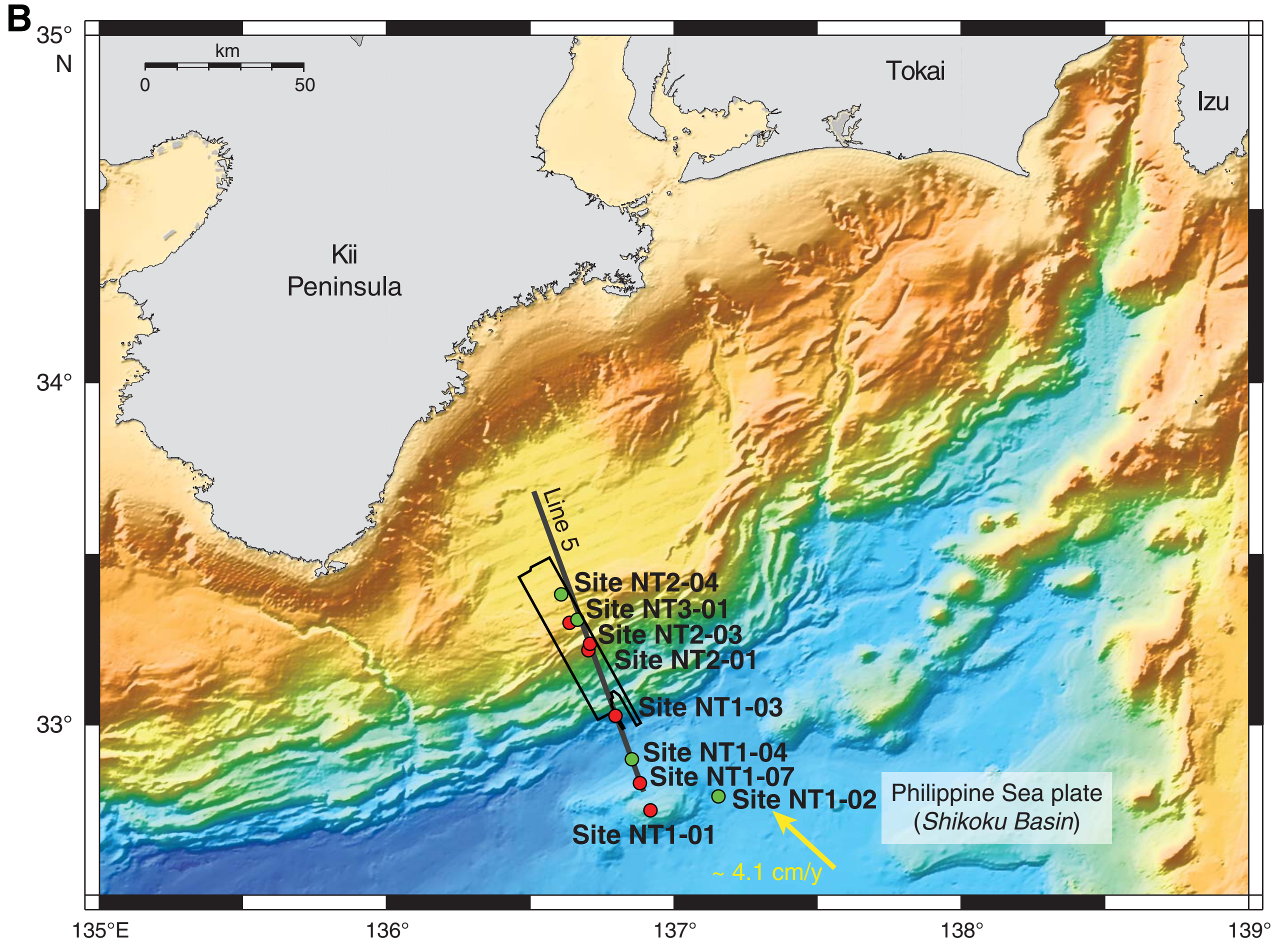


Figure F2. Line KR0108-5 (see Fig. **F1B**). **A.** Uninterpreted (prestack, depth migration) shows structure of Nankai Trough accretionary prism (from Park et al., 2002). **B.** Interpretation shows locations of Stage 1 sites slated for LWD, coring, and downhole measurement/CORK installation (after Tobin and Kinoshita, 2006). Solid rectangles = TD planned for Stage 1, open rectangles = TD planned for future operations. The extent of coseismic rupture in the 1944 Tonankai (M 8.2) great earthquake determined from tsunami (red arrows) (Tanioka and Satake, 2001) and seismic (blue arrows) (Kikuchi et al., 2003) waveform inversions are shown above the seismic lines.

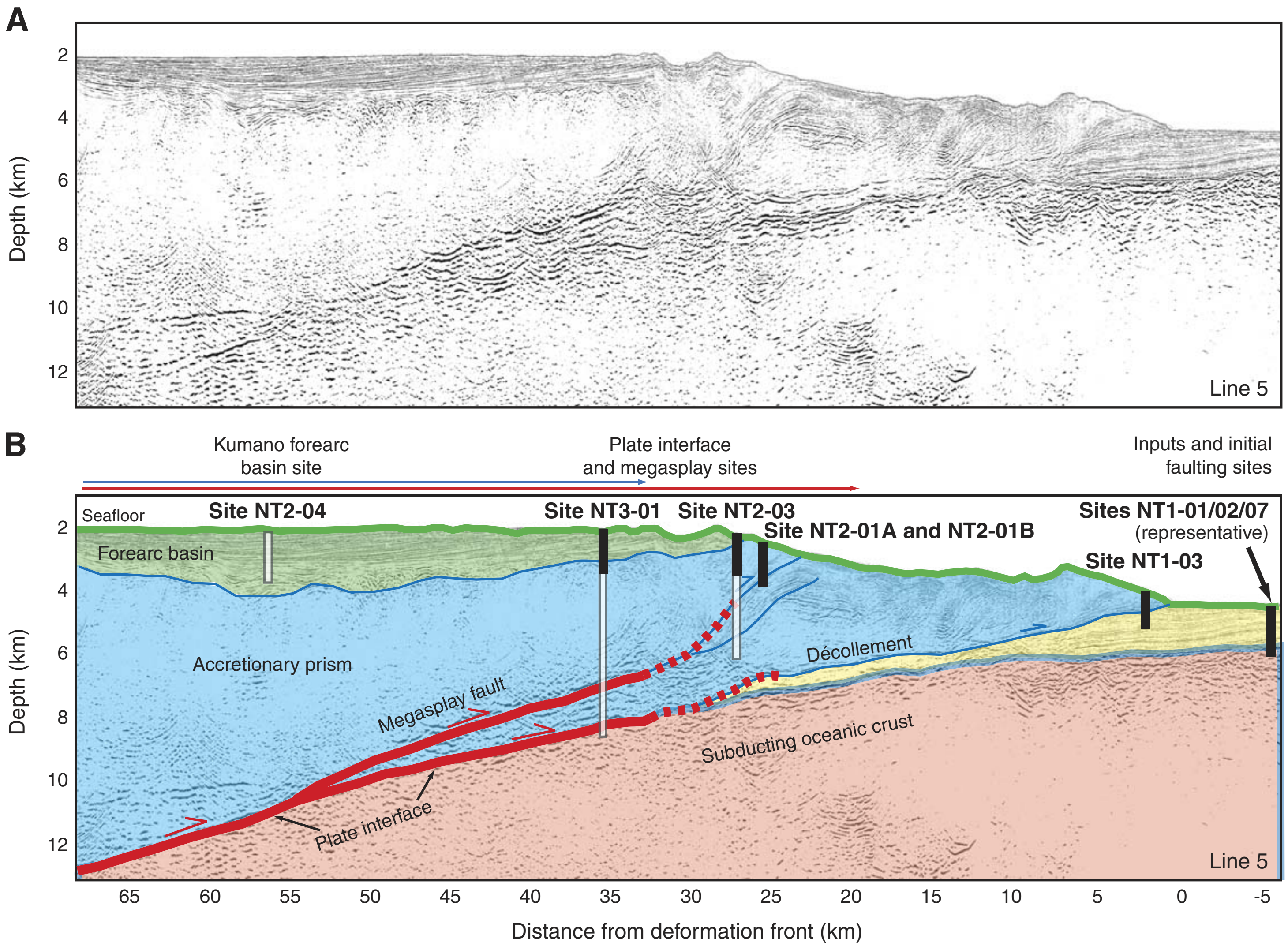


Figure F3. Bathymetric map of the Nankai accretionary prism off Kumano showing drill sites and cold seep locations as determined by *Shinkai 6500* dives. Gray outline = three-dimensional (3-D) seismic survey area. Red lines = 3-D seismic tracks on which the drill sites of this expedition are located. Depths in meters are indicated by the numbers along their respective isoclines.

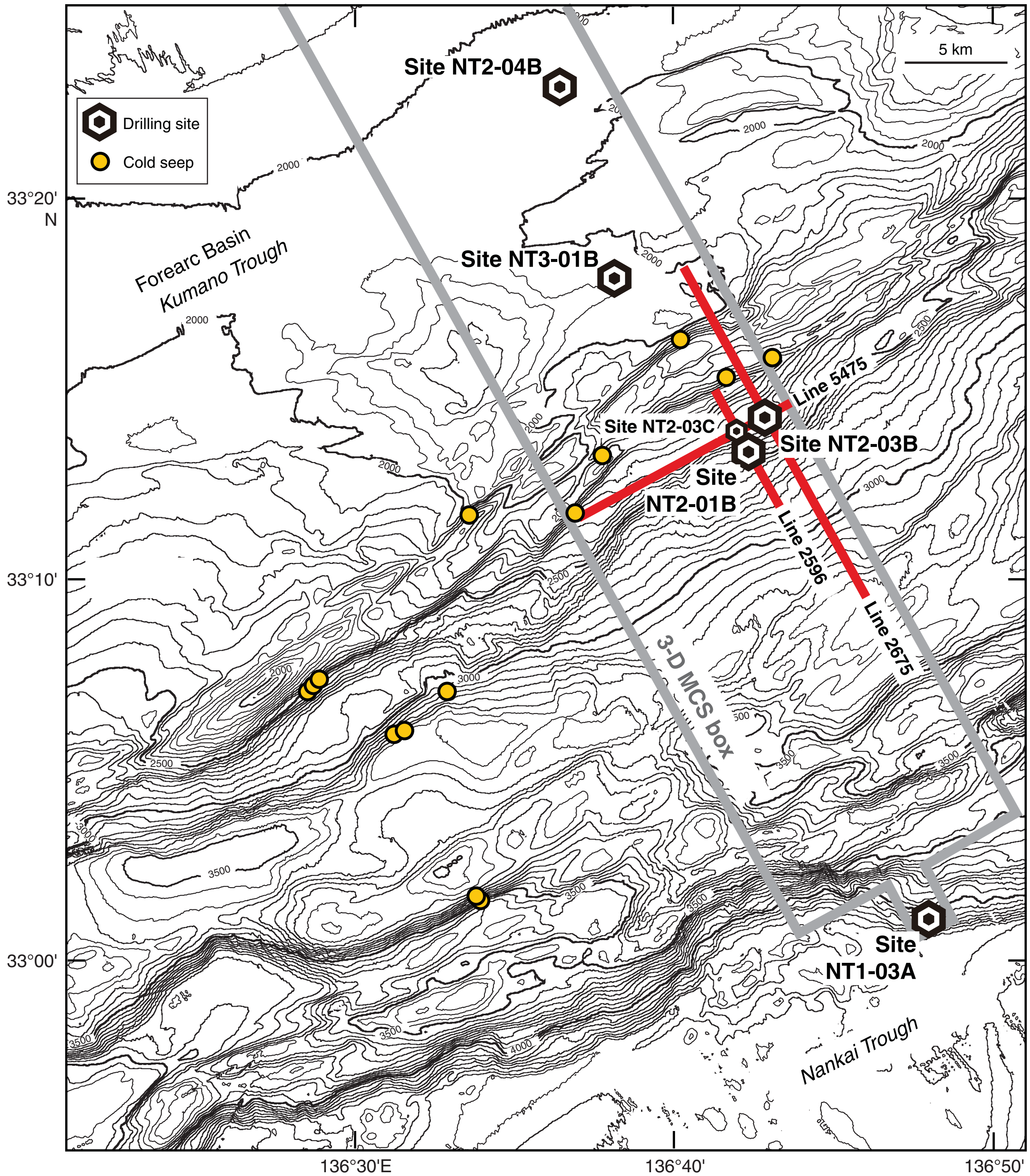


Figure F4. A. Seismic cross-section of drill site taken by three-dimensional reflection seismic survey in 2006. **B.** Interpretation of A. Red line = fault, blue line = unconformity. Black box = area of close-up view shown in Figure F5.

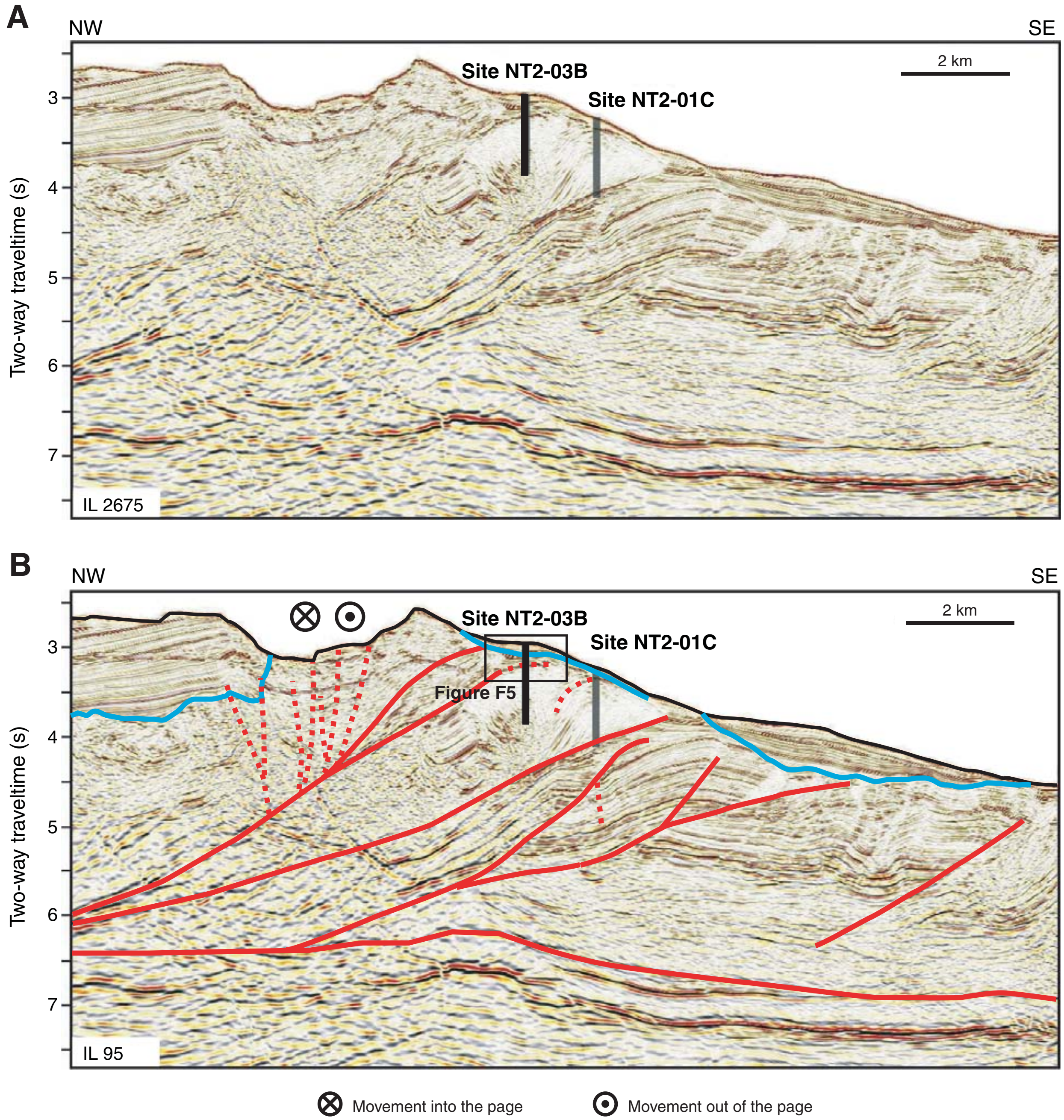


Figure F5. Close-up view of the inline three-dimensional seismic cross-section (IL2675) around the drill site, showing slump deposits and the uppermost portion of the accretionary prism. Area of view is indicated in Figure **F4B.**

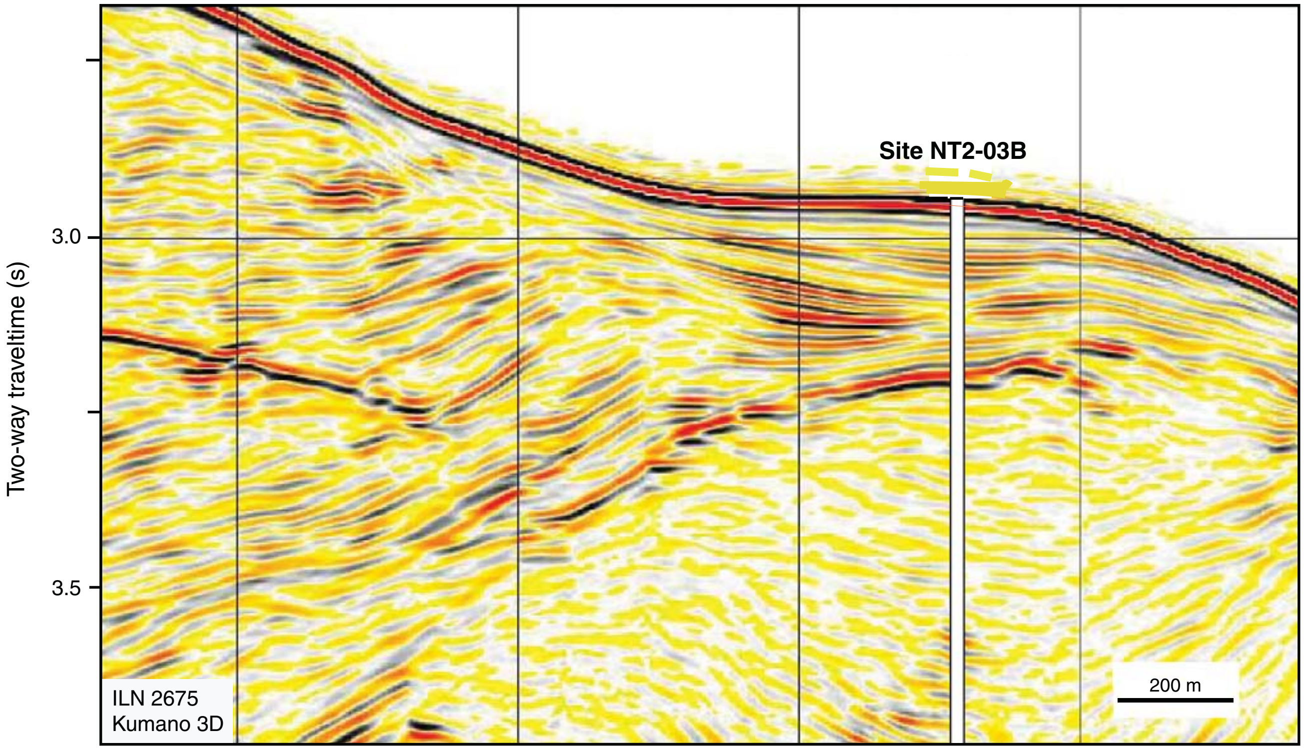


Figure F6. Three possible structural interpretations for the discontinuity at ~210 mbsf. BSR = bottom-simulating reflector. **A.** Propagation of the deformation related to the upper splay fault (USF) stops landward-of proposed Site NT2-03B. **B.** Deformation propagates on a detachment surface along, or more probably close, to the basal unconformity. **C.** Precisely at the location of proposed Site NT2-03B, a faint landward dipping reflector cutting the basin reflectors is shown. This can be interpreted as a thrust, although we cannot completely rule it out as a sedimentary feature. Such a thrust could be the updip extension of the USF covered with only a very thin gliding unit.

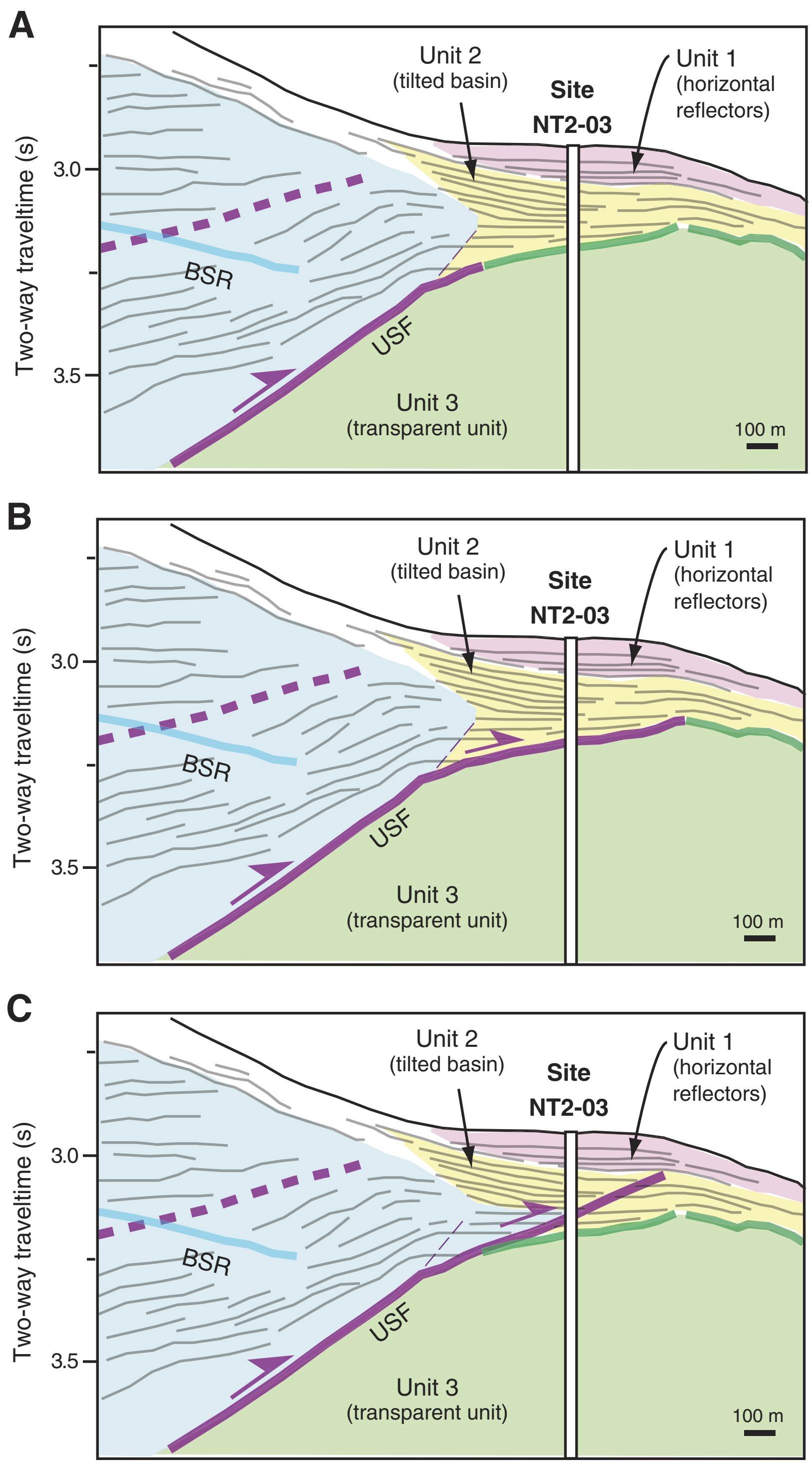


Figure F7. Three-dimensional side-scan image collected by deep-tow side-scan sonar *Wadatsumi* over Kumano Basin and forearc slope showing the roughness and steepness of the proposed drill sites. A north-northeast–south-southwest trending lineament is clearly observed in the depression between the outer ridge and the forearc basin. Aerial coverage is shown in Figure F8, which does not include sites in the trench or the reference sites on the Philippine Sea plate (proposed Sites NT1-03, NT1-04, NT1-02, and NT1-07).

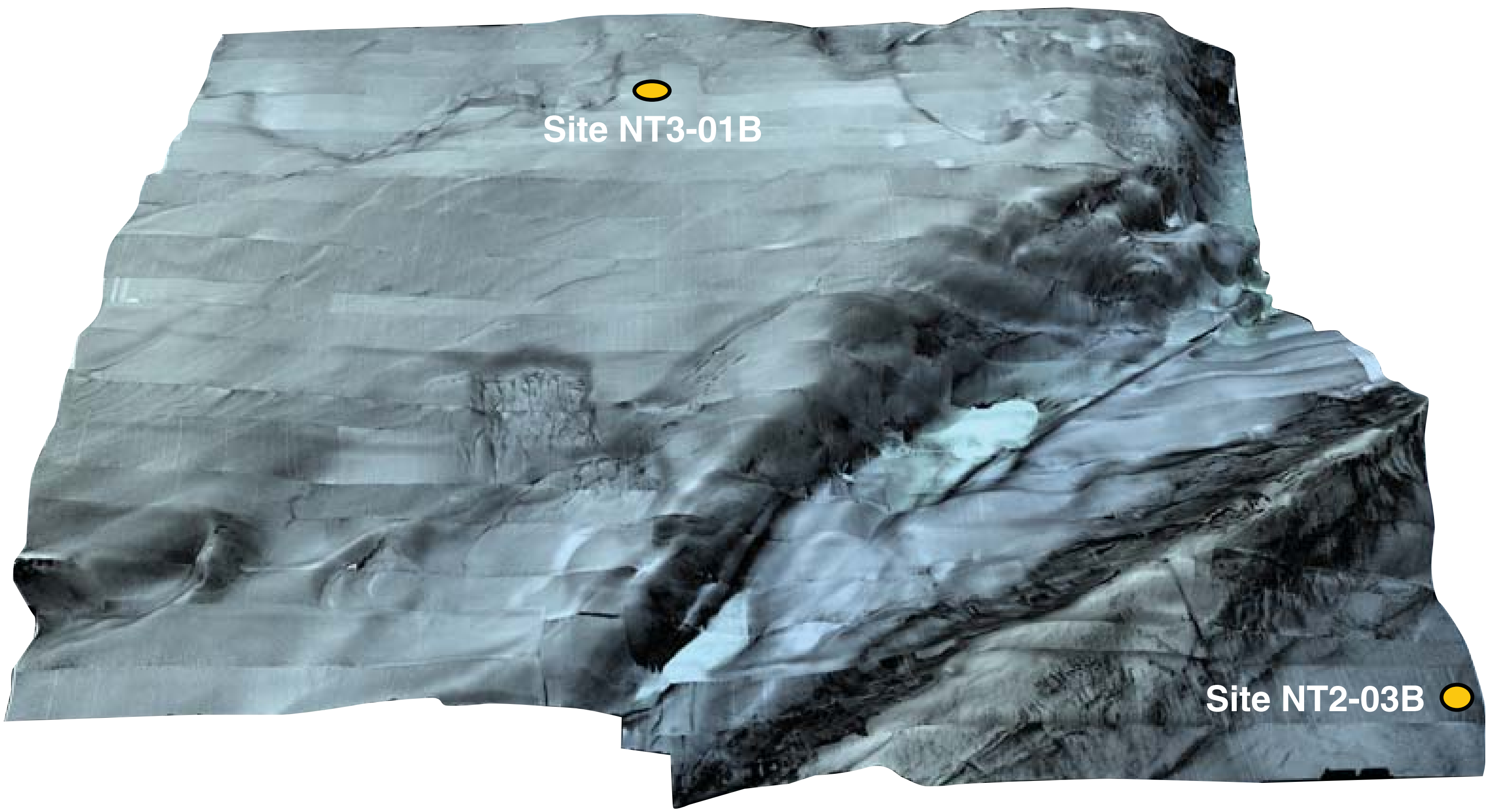


Figure F8. Bathymetric map showing the strike-slip fault zone (between red dotted lines). Shear sense is estimated to be dextral, based on the gap of the canyon axis (arrows A and B). Depth in meters is indicated by the numbers in white boxes along their respective isoclines.

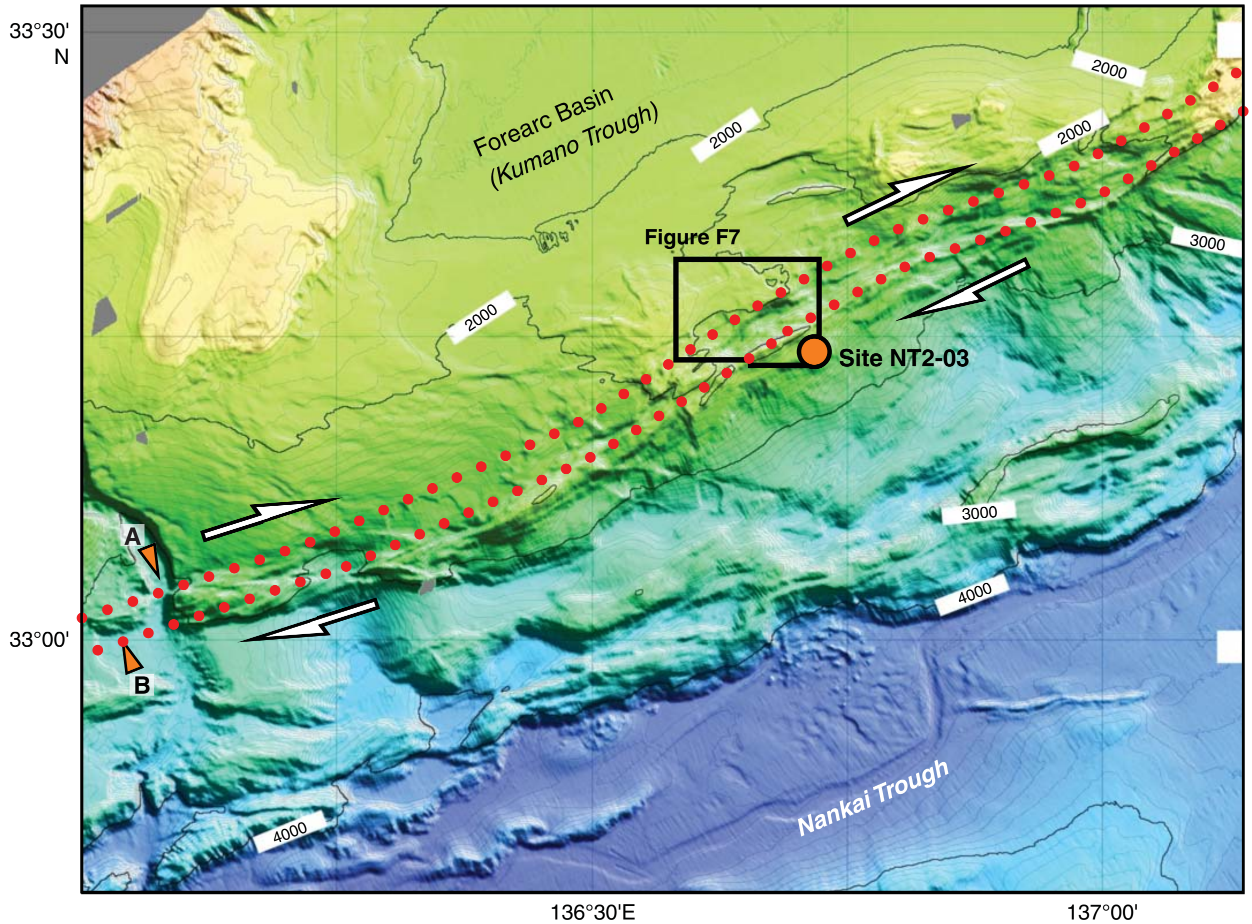


Figure F9. Trace of normal (green) and reverse (pink) faults on a three-dimensional seismic cross-section (IL2570). Normal faulting is dominant in the (**A**) forearc basin side, whereas both normal and reverse faults are recognized on the (**B**) seaward flank of the outer-arc high.

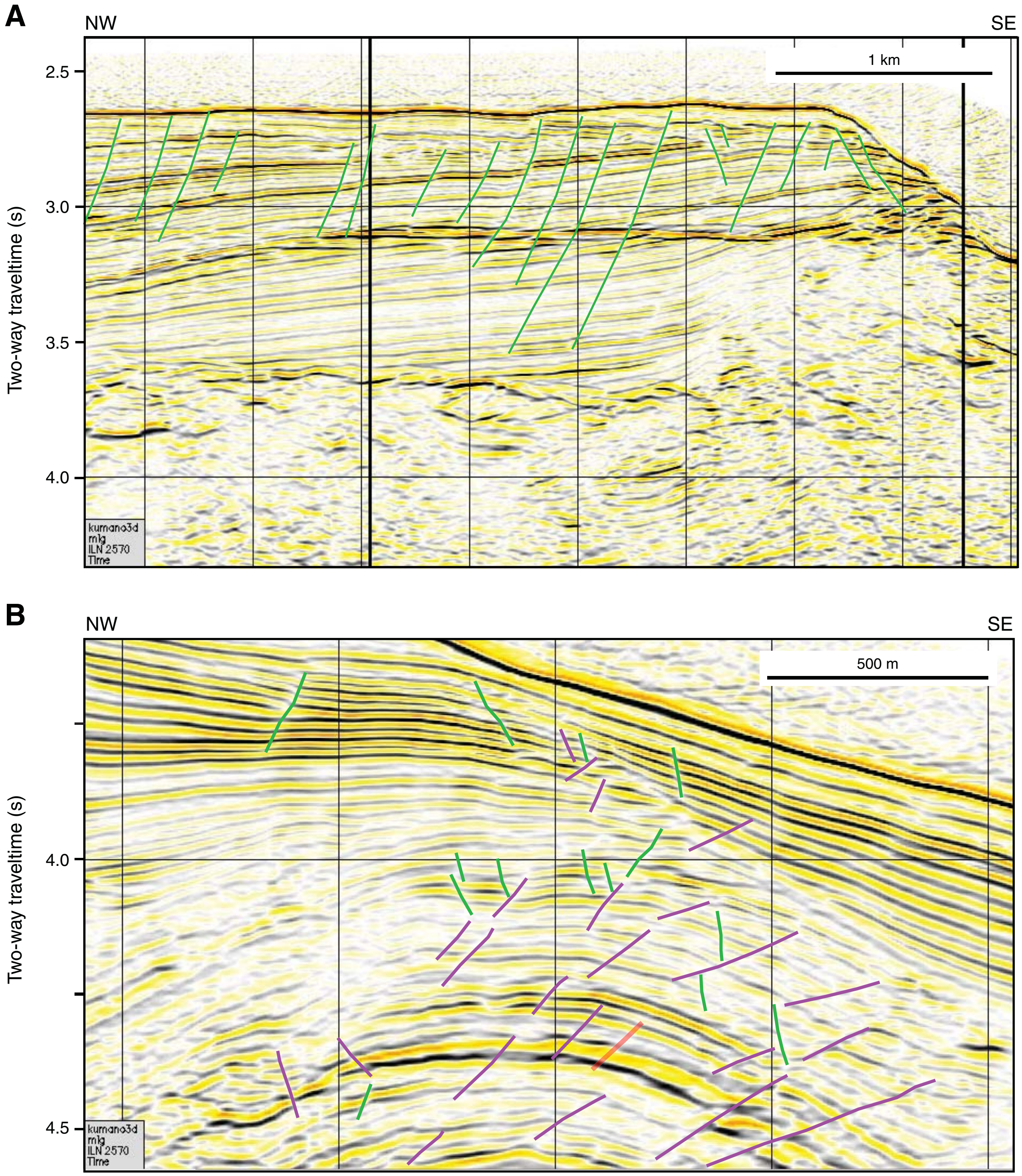


Figure F10. Proposed Site NT2-03 conceptual drilling diagrams. LWD = logging while drilling, HPCS = hydraulic piston coring system, ESCS = extension shoe coring system, VSP = vertical seismic profile, RCB = rotary core barrel.

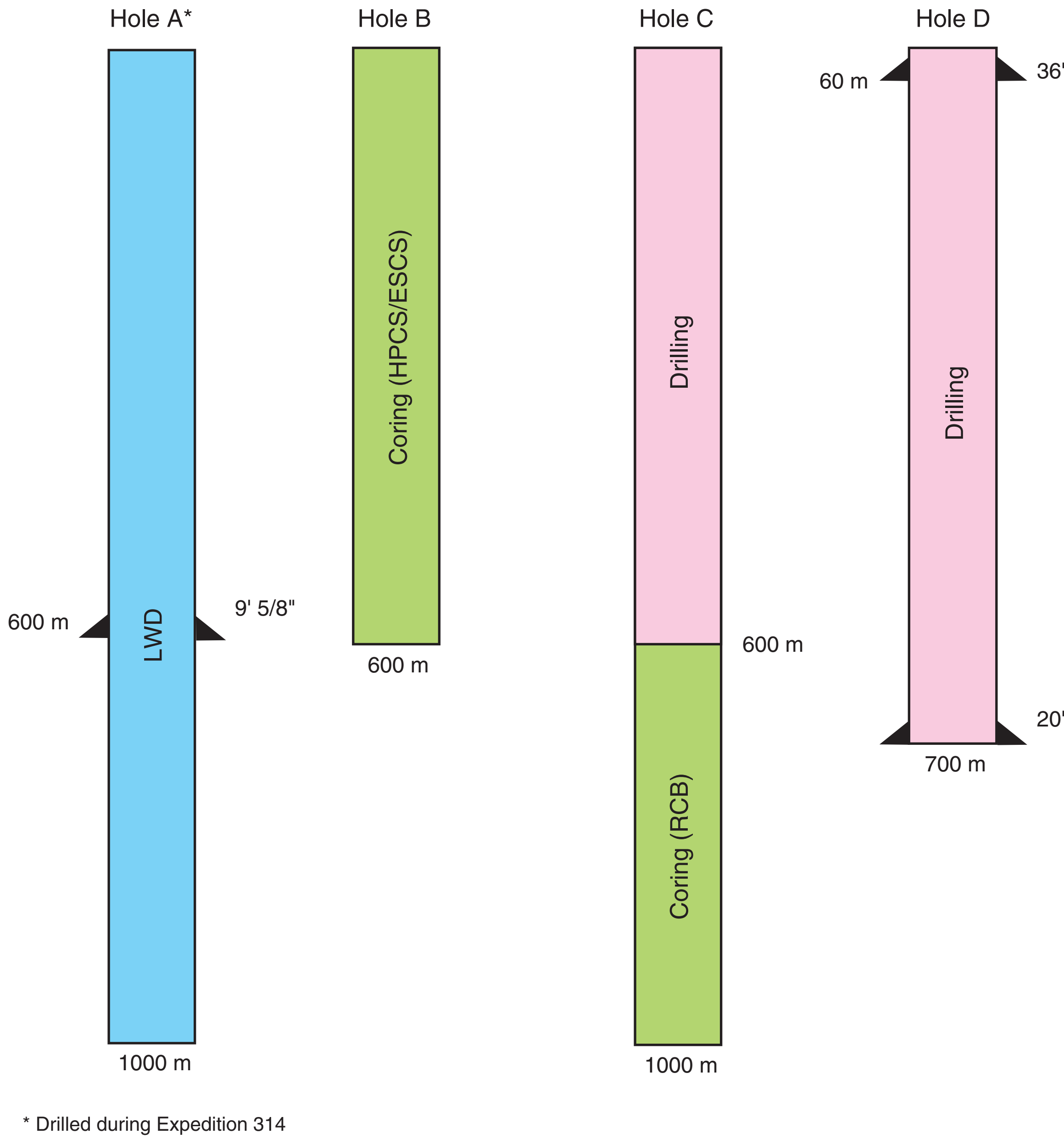


Figure F11. Drilling chart for Expedition 315.

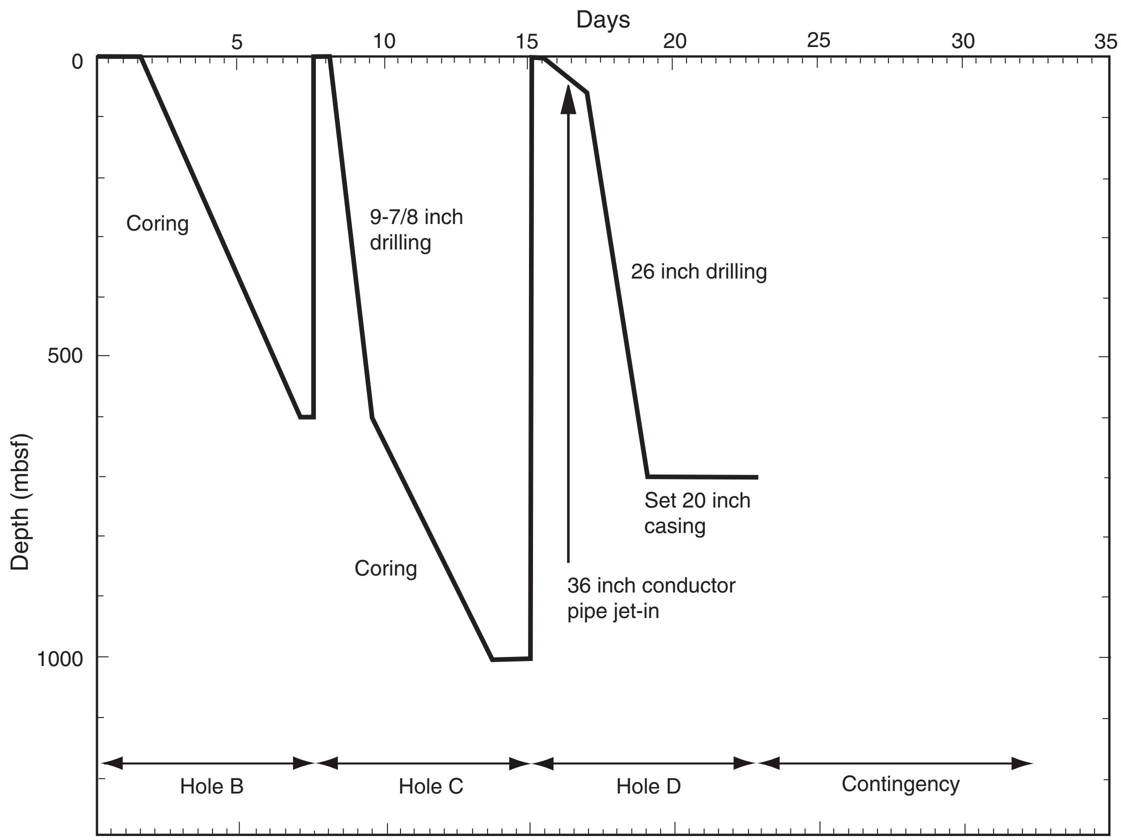
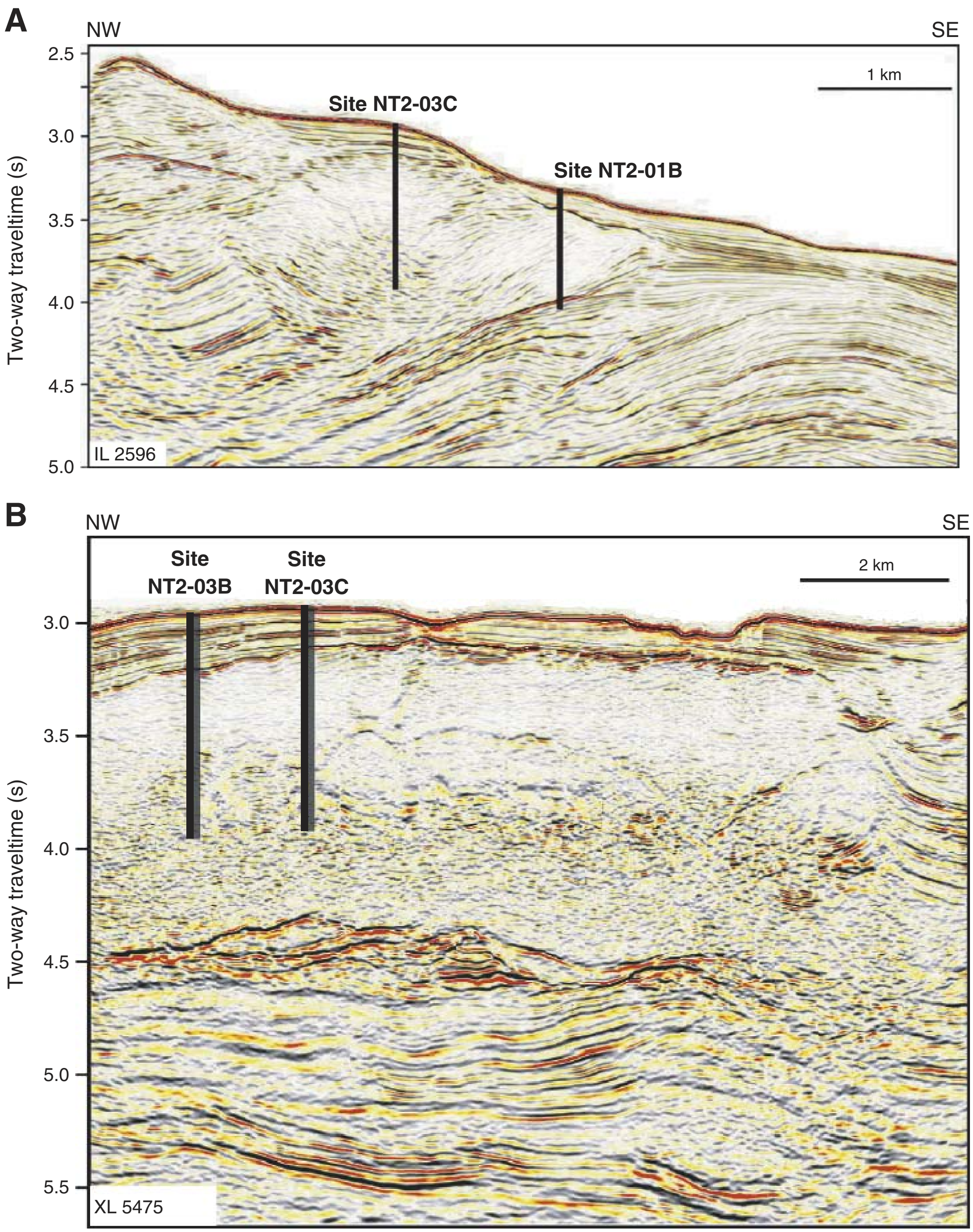


Figure F12. Cross-section of proposed Site NT2-03C. **A.** Inline section (IL2596). Vertical exaggeration (VE) = 1.75. **B.** Cross-line section (XL5475). VE = 4.1.



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 and into oceanic crust • 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: 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.

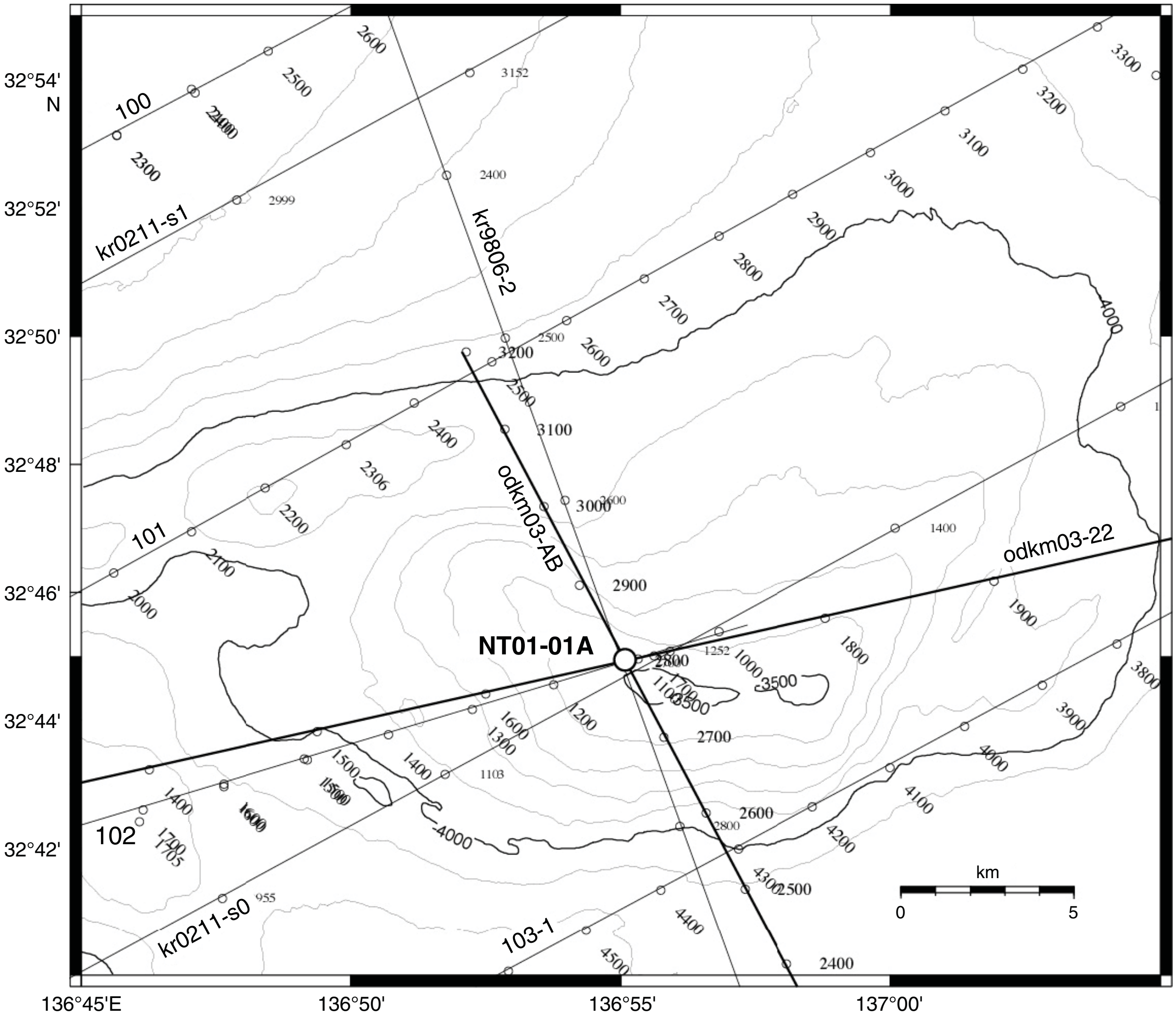


Figure AF2. Line ODKM03-AB.

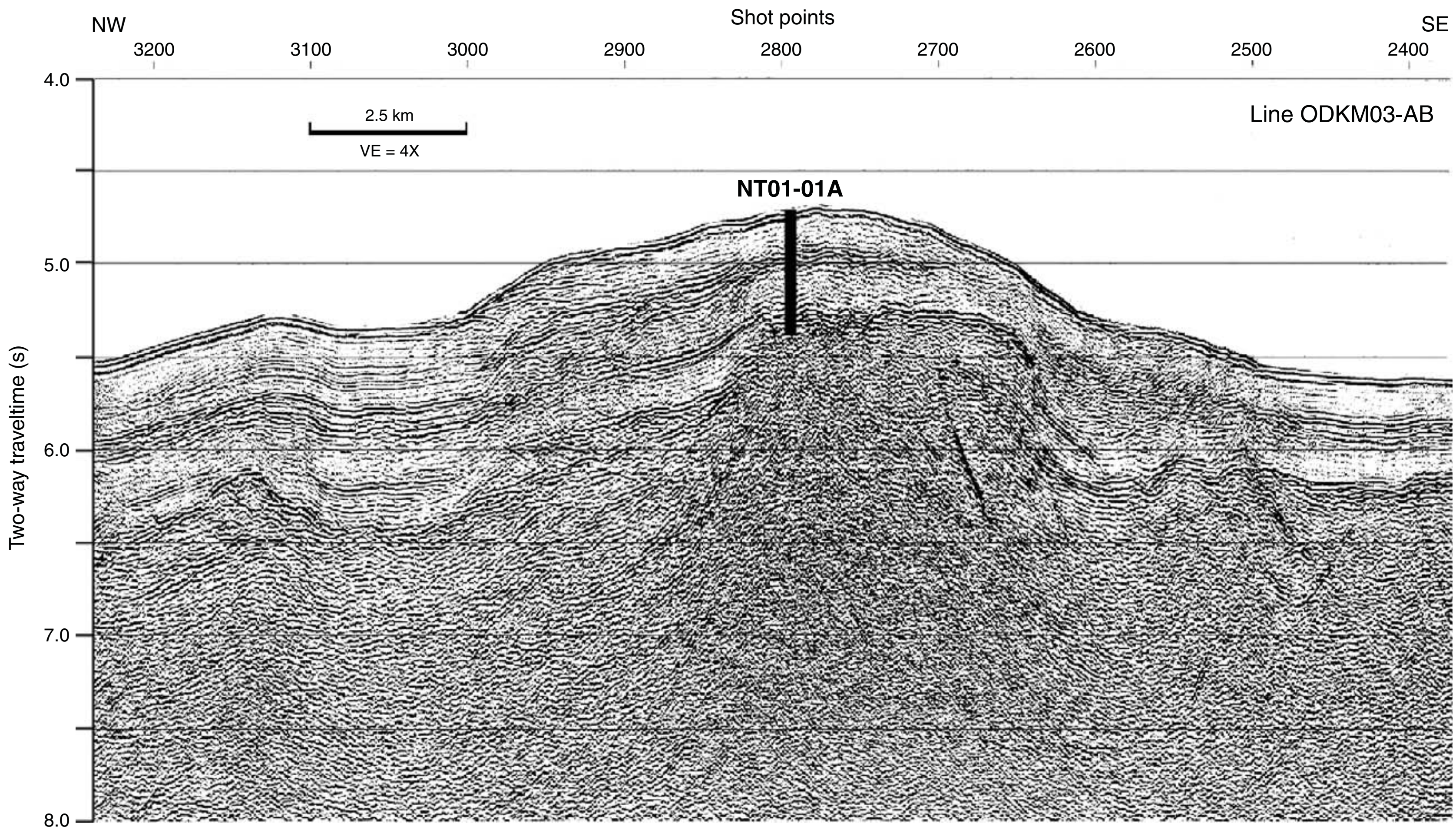


Figure AF3. Line ODKM03-22.

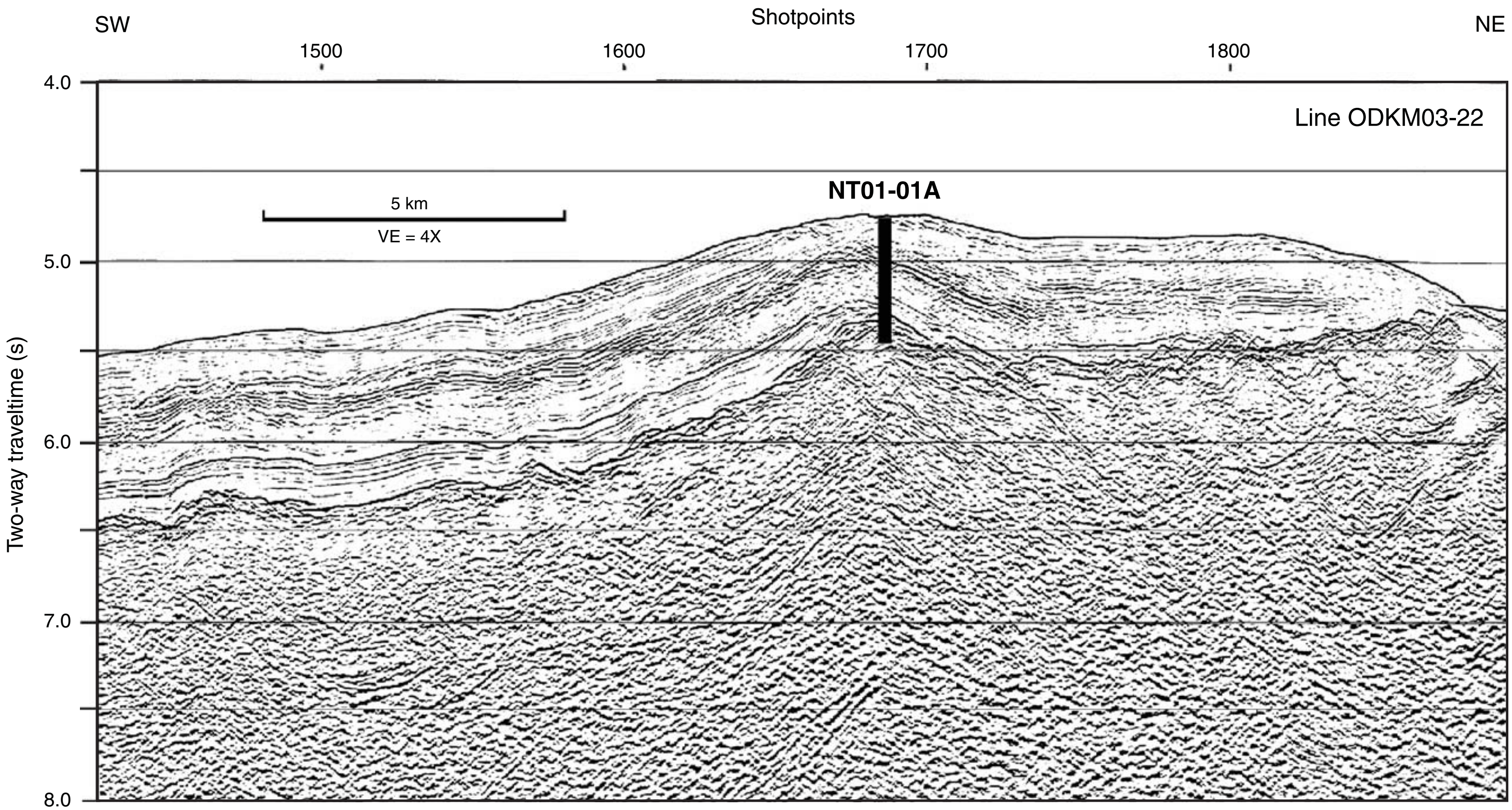


Figure AF4. Track map, Site NT1-04C.

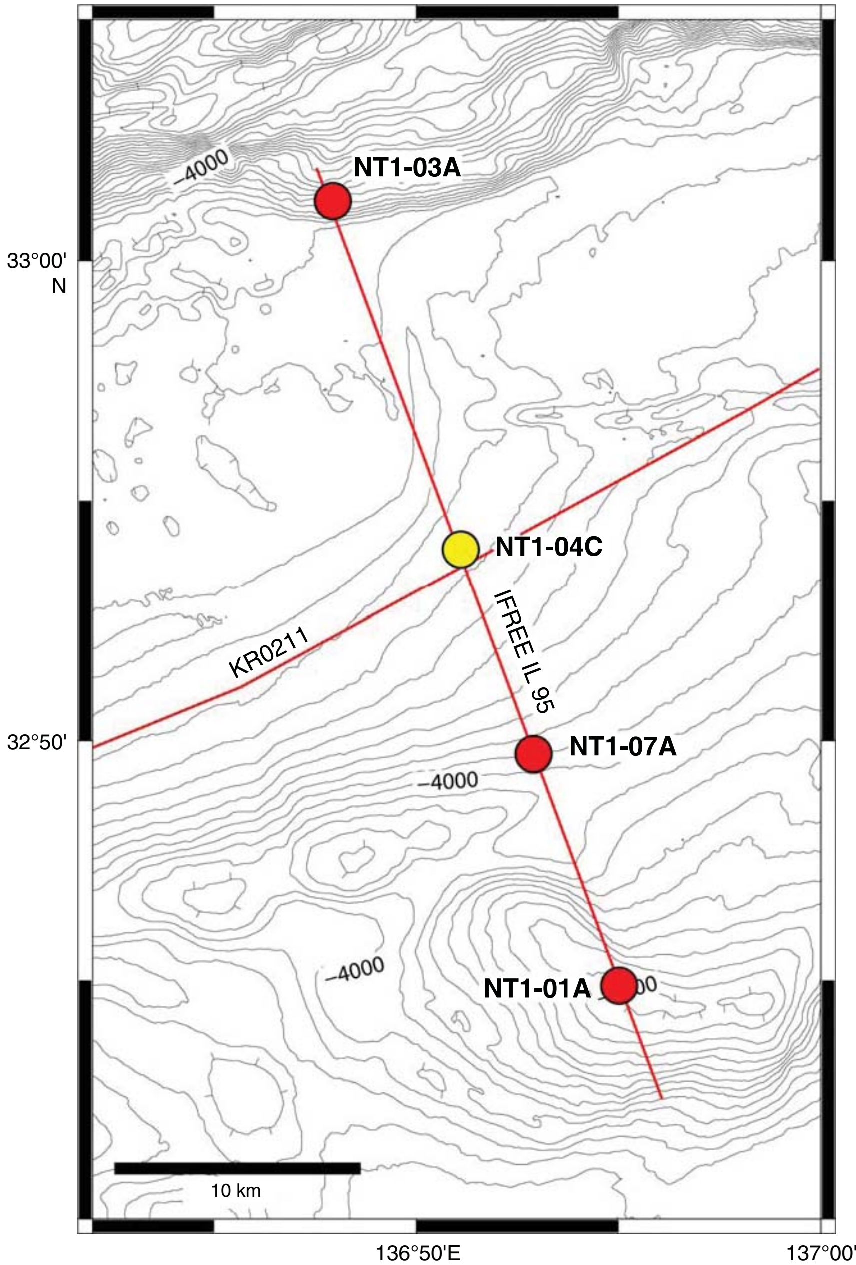


Figure AF5. Inline 95.

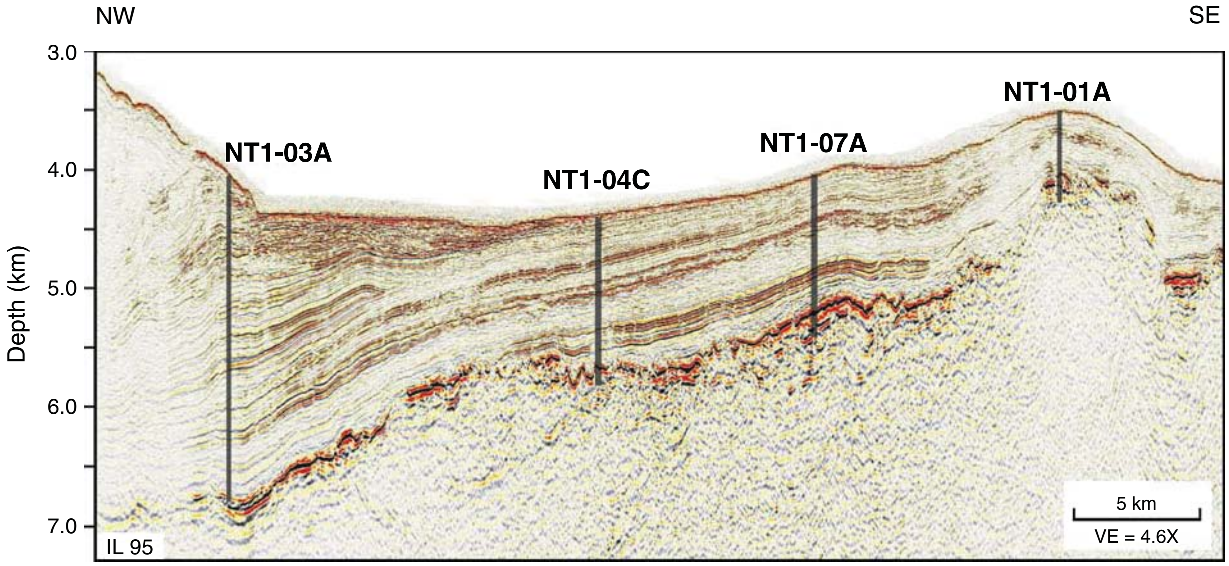


Figure AF6. Inline 95.

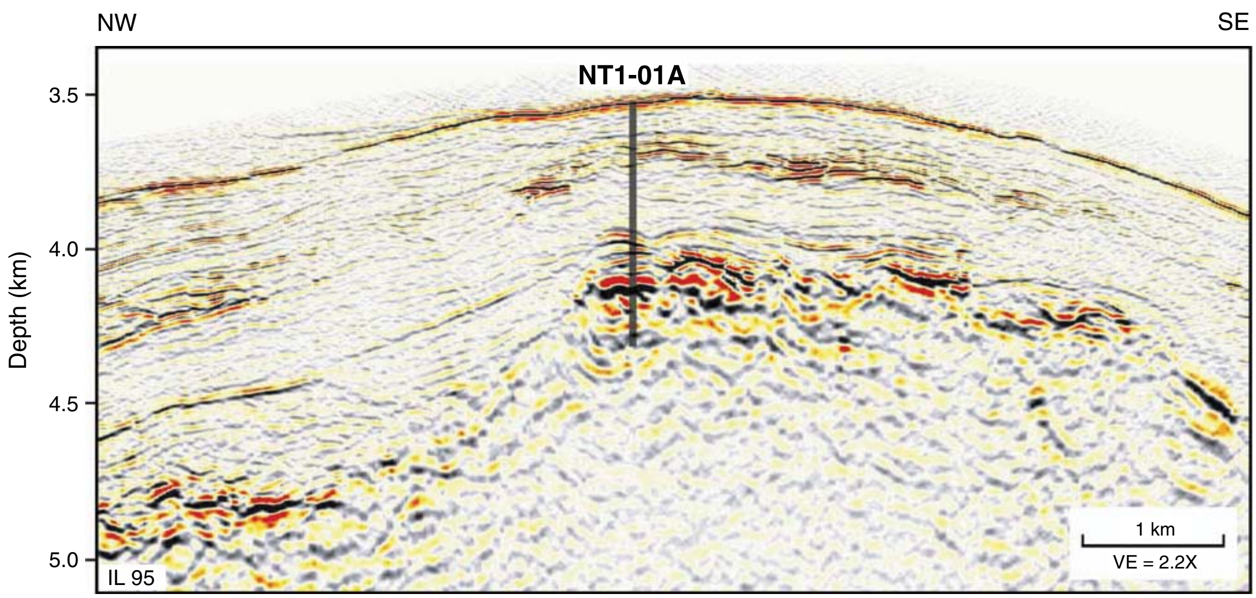


Figure AF7. Track map, Site NT1-02A.

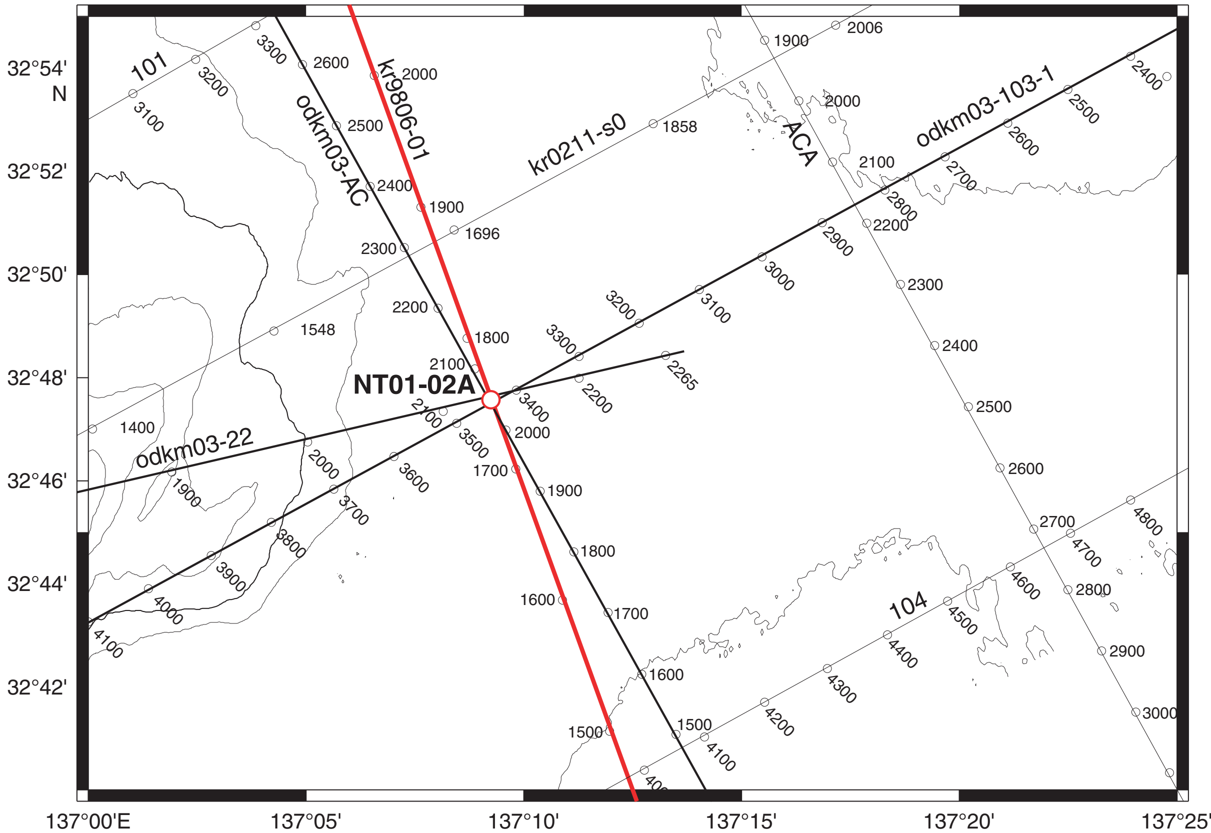


Figure AF8. Line ODKM03-22.

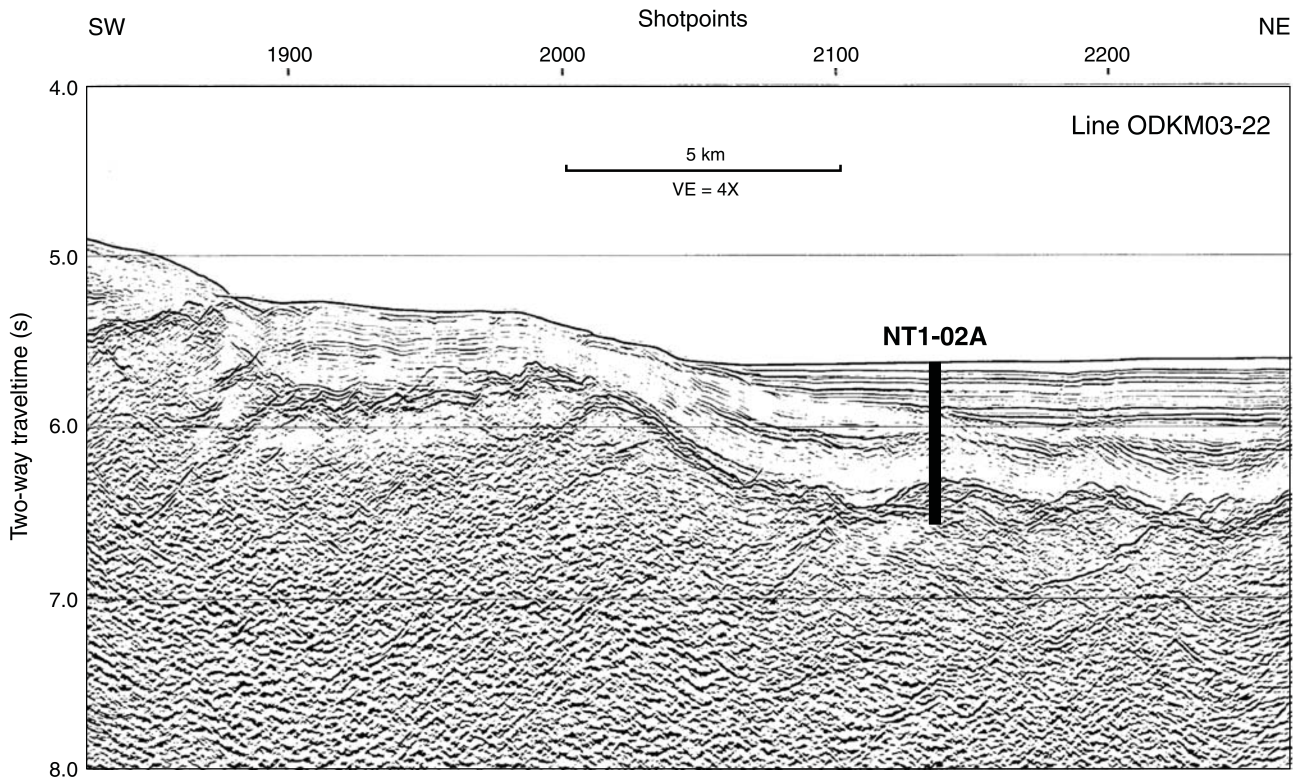


Figure AF9. Line ODKM03-103-1.

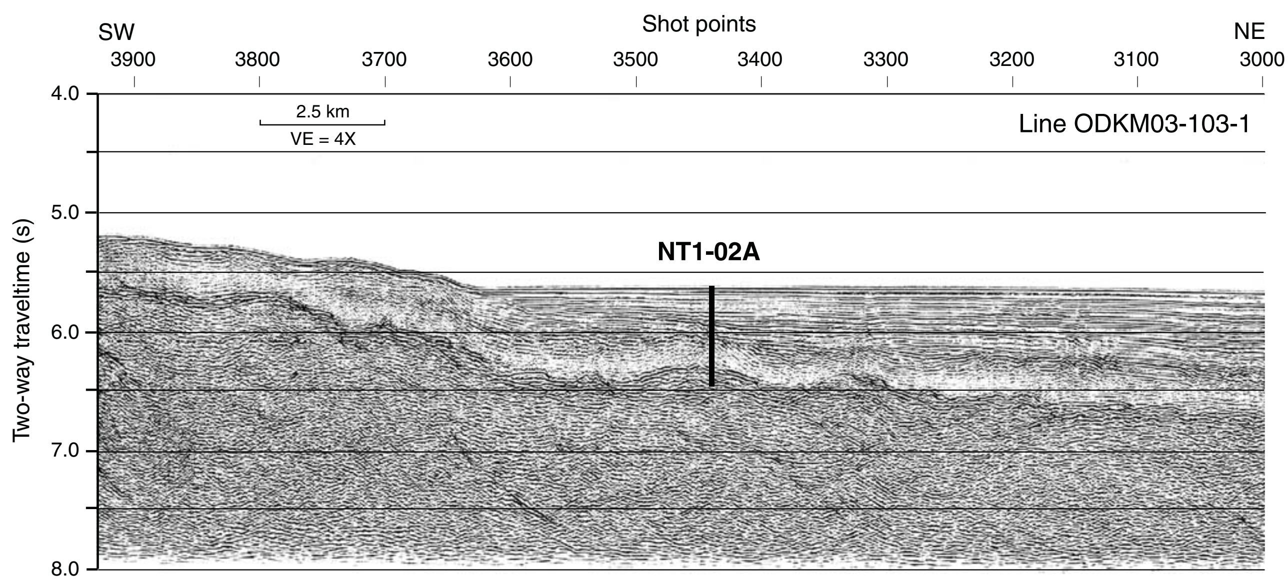


Figure AF10. Line KR9806-1.

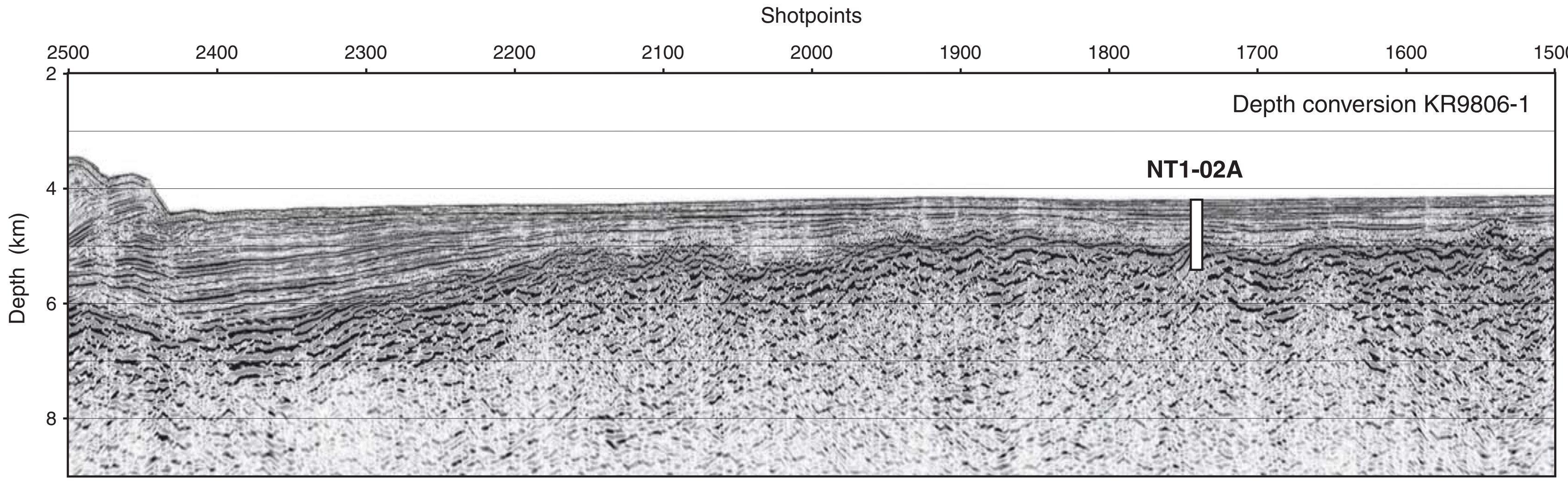


Figure AF11. Track map, Site NT1-03A.

Figure AF12. Line ODKM03-K.

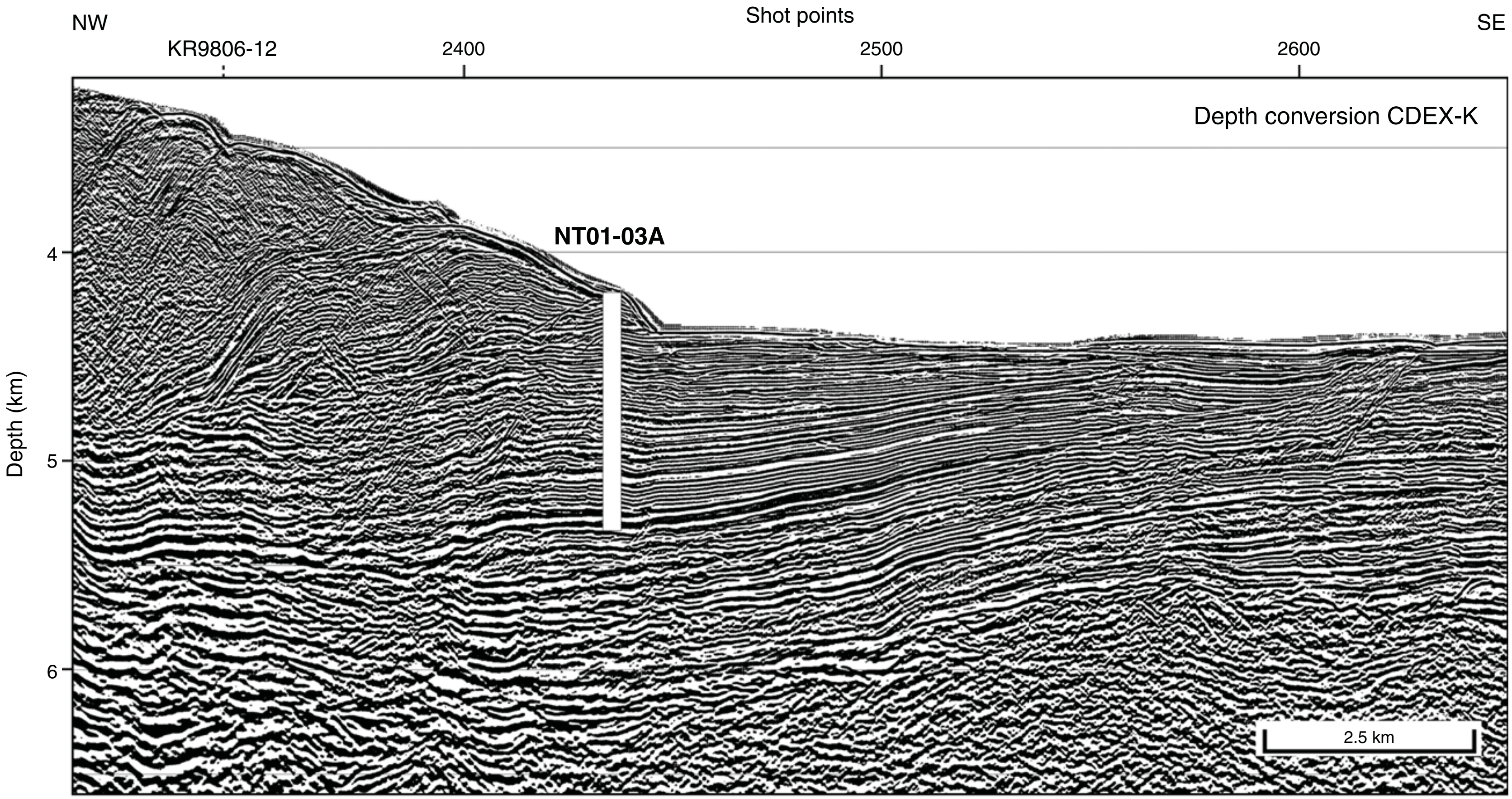


Figure AF13. Line KR9806-12.

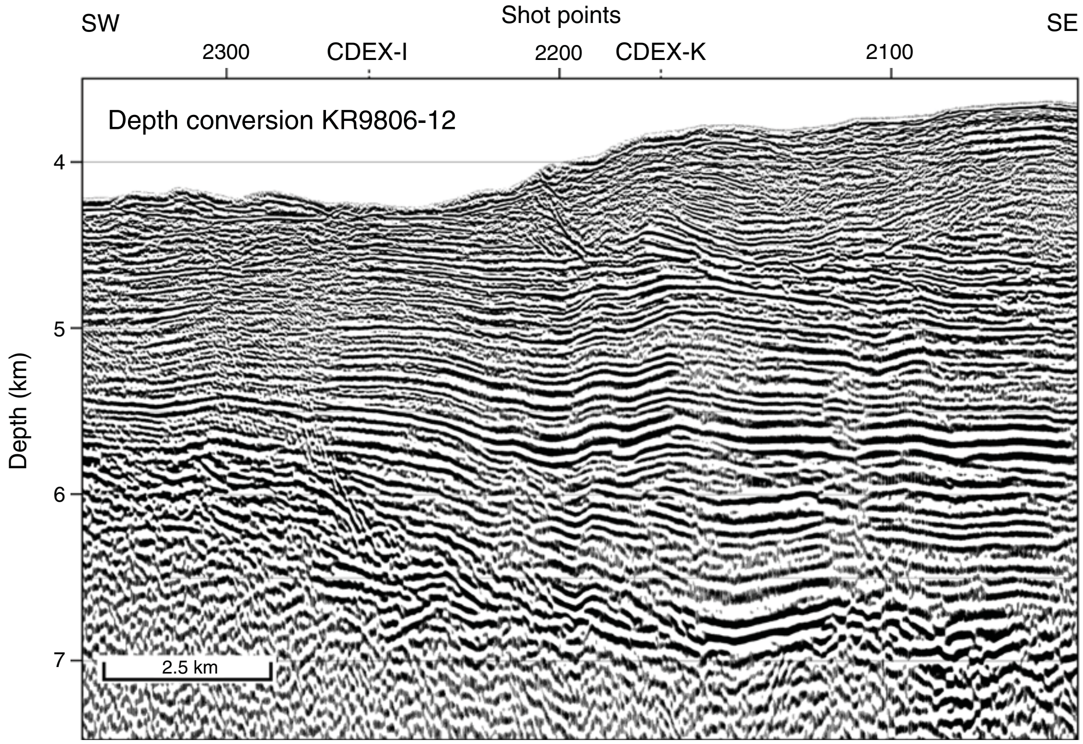


Figure AF14. Inline.

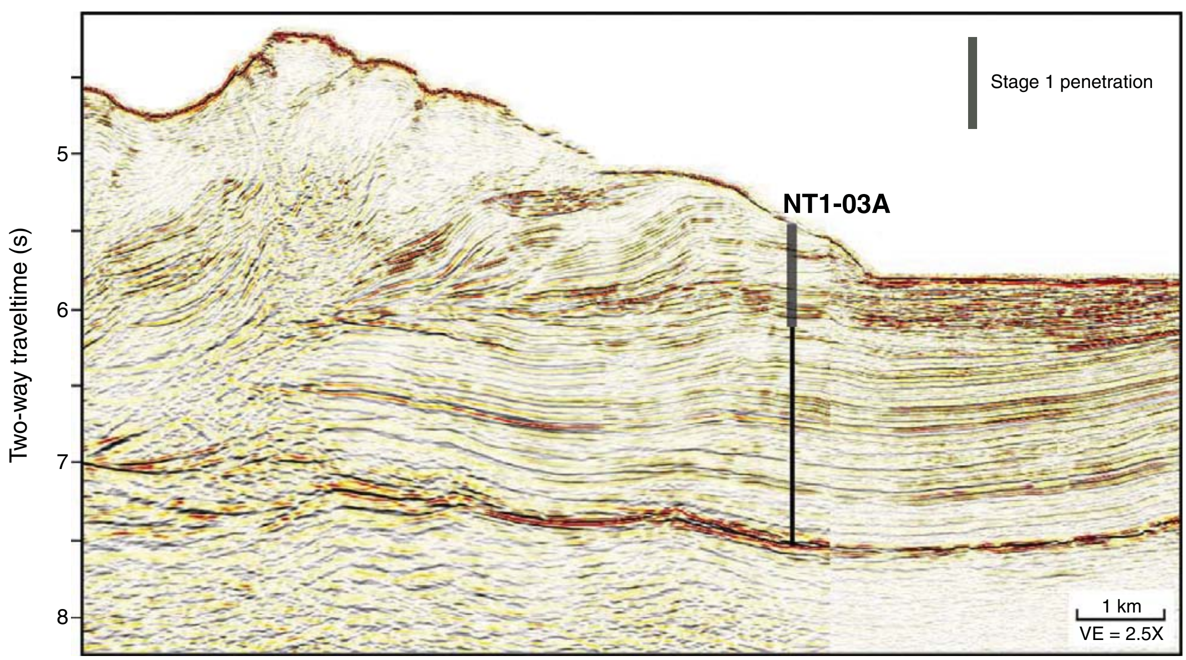


Figure AF15. Site map, NT1-03.

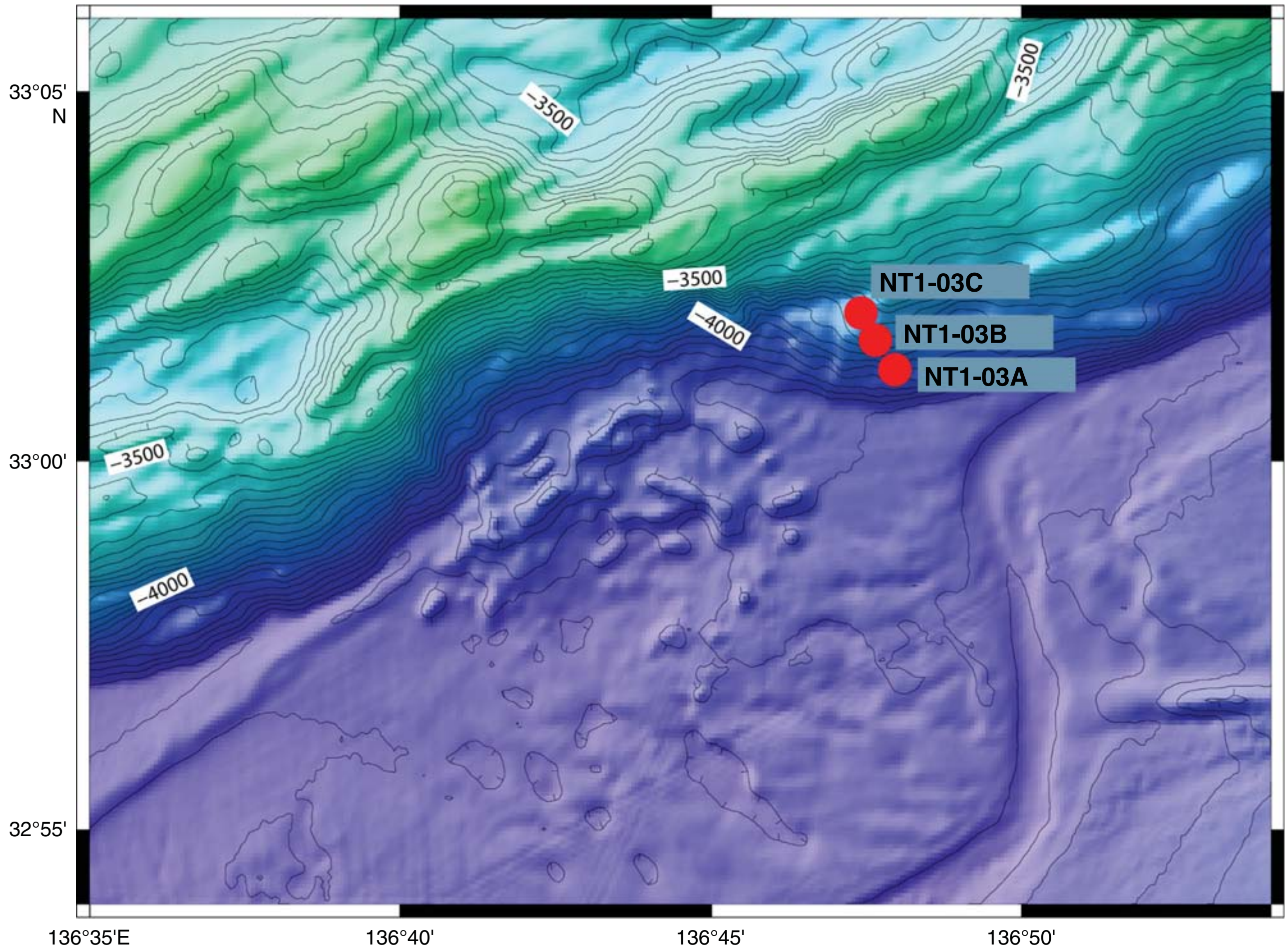


Figure AF16. Inline.

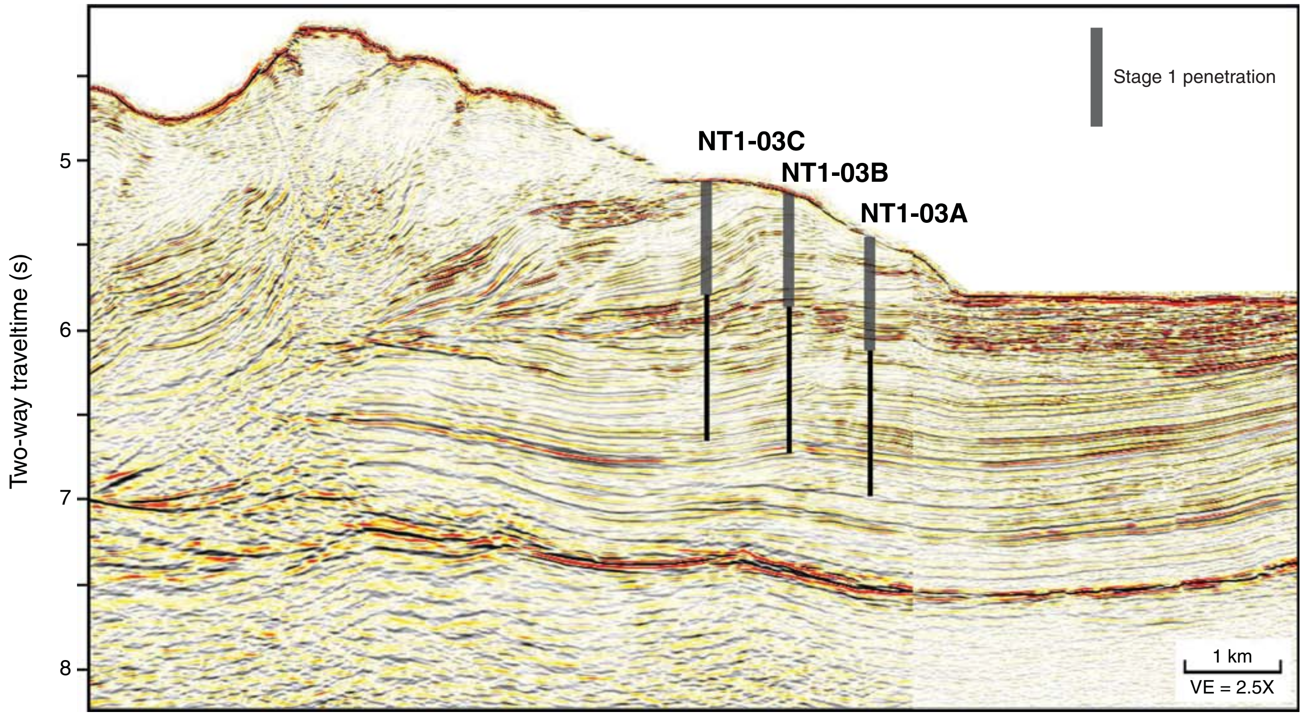


Figure AF17. Inline 95.

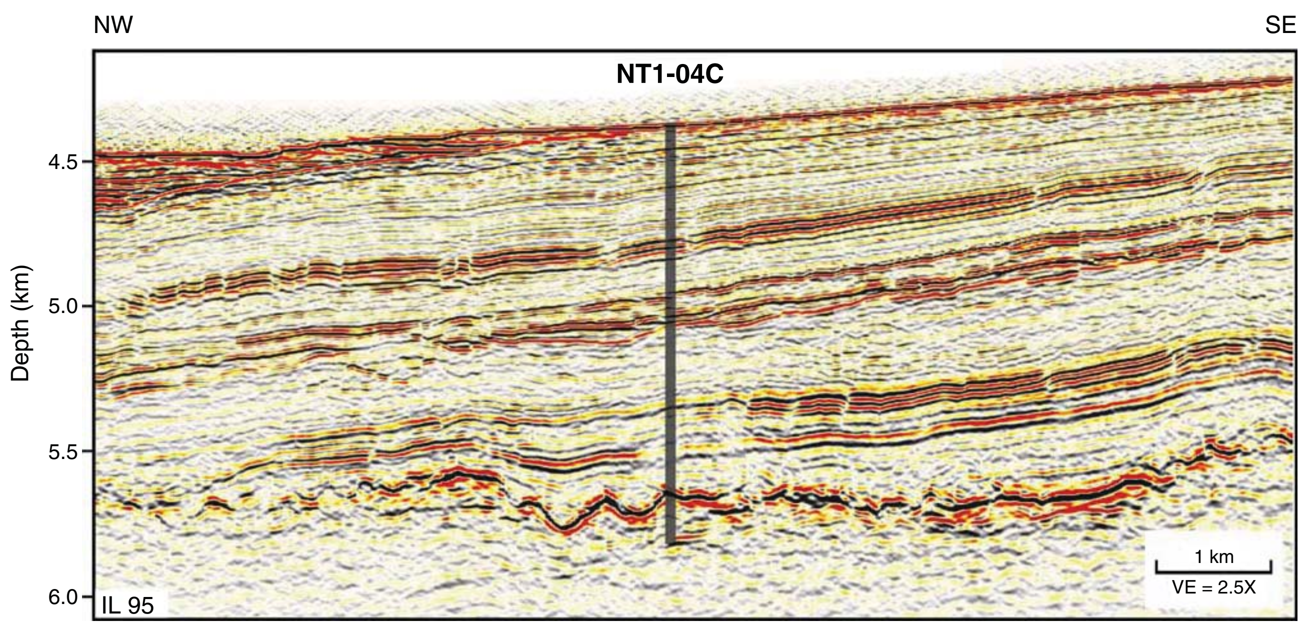


Figure AF18. Line 1151.

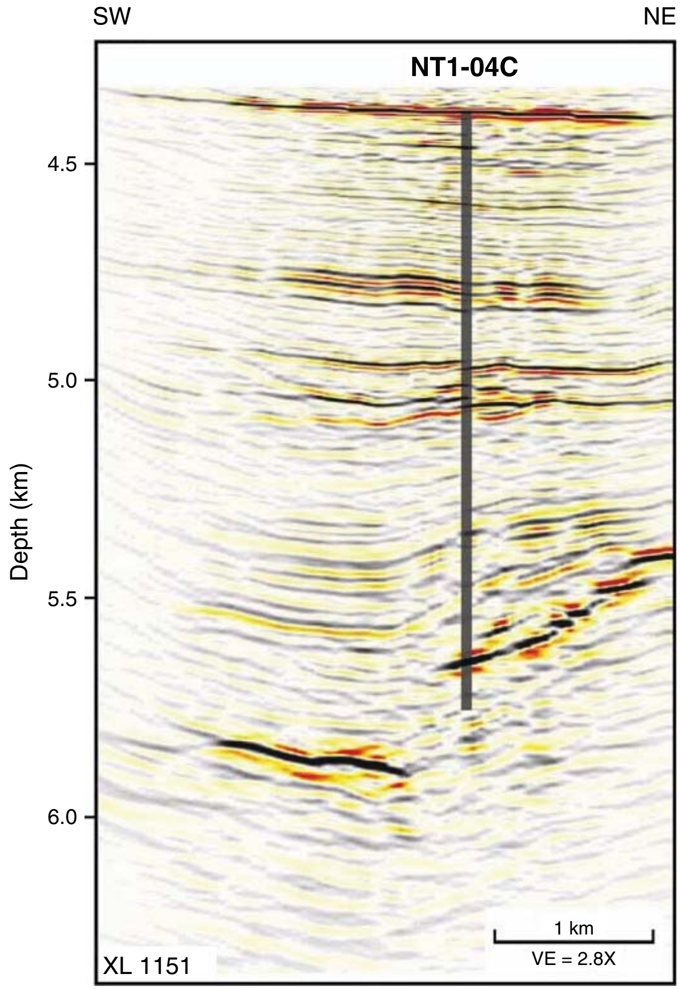


Figure AF19. Line KR0211.

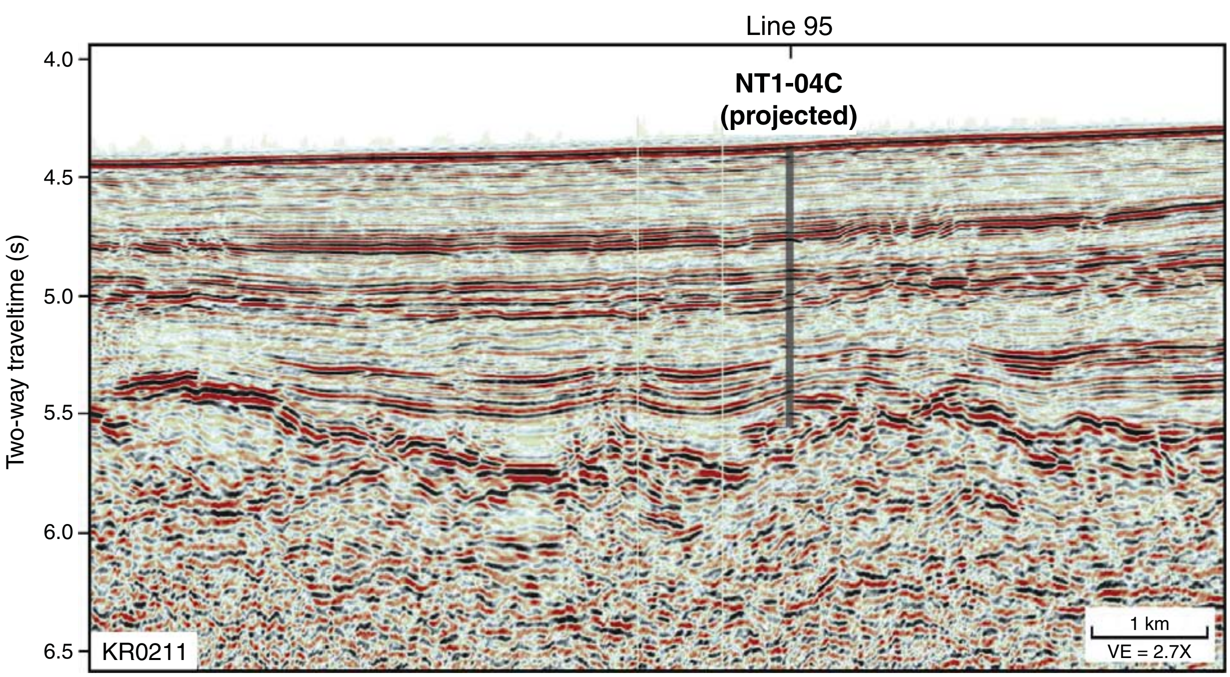


Figure AF20. Track map, Site NT1-07A.

Figure AF21. Line ODKM 03-101.

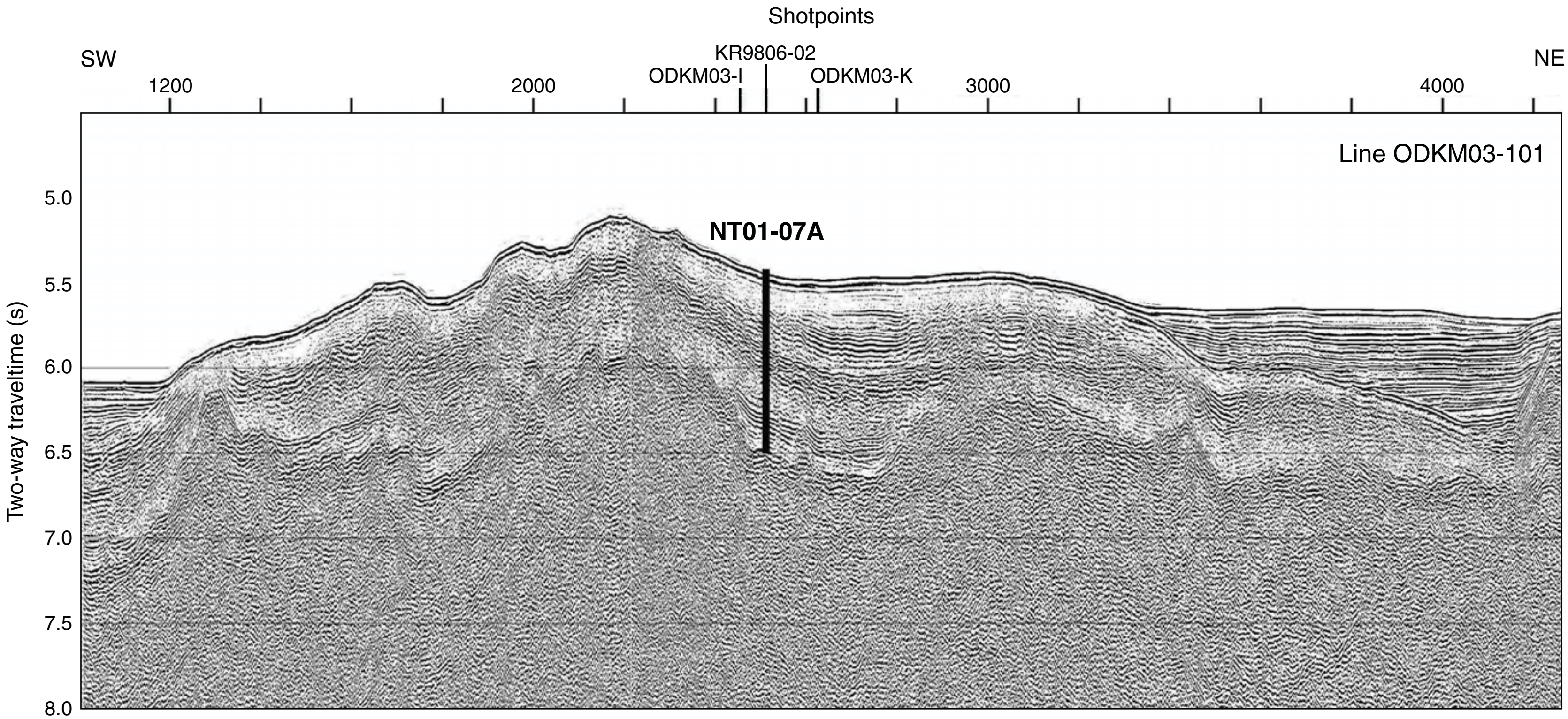


Figure AF22. Inline 95.

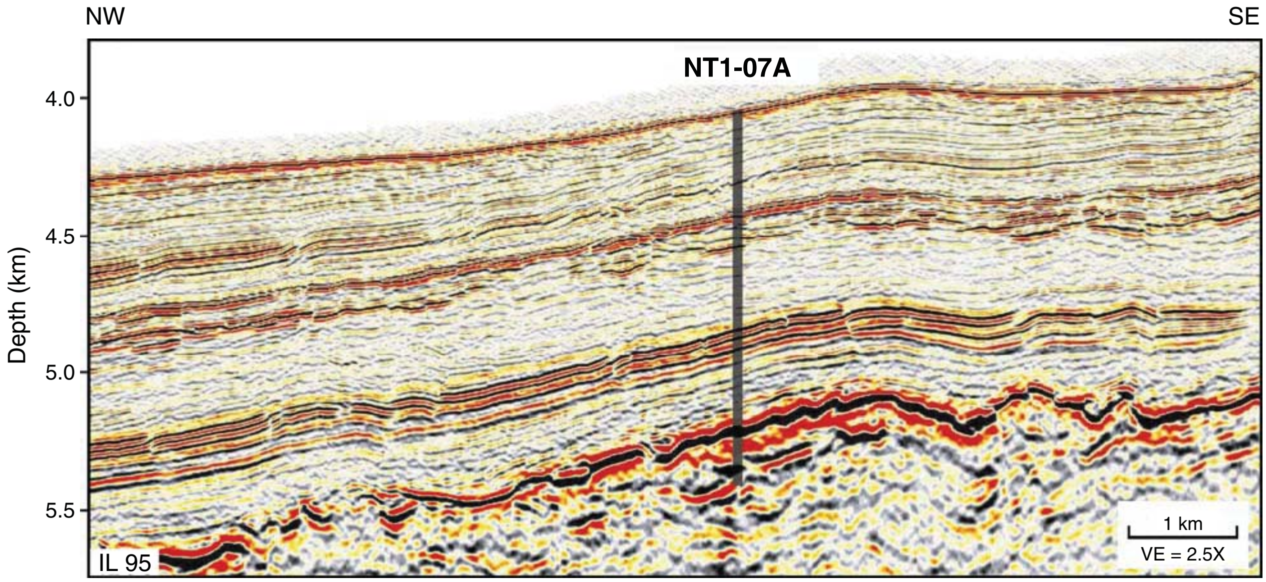


Figure AF23. Track map, Sites NT2-01 and 03.

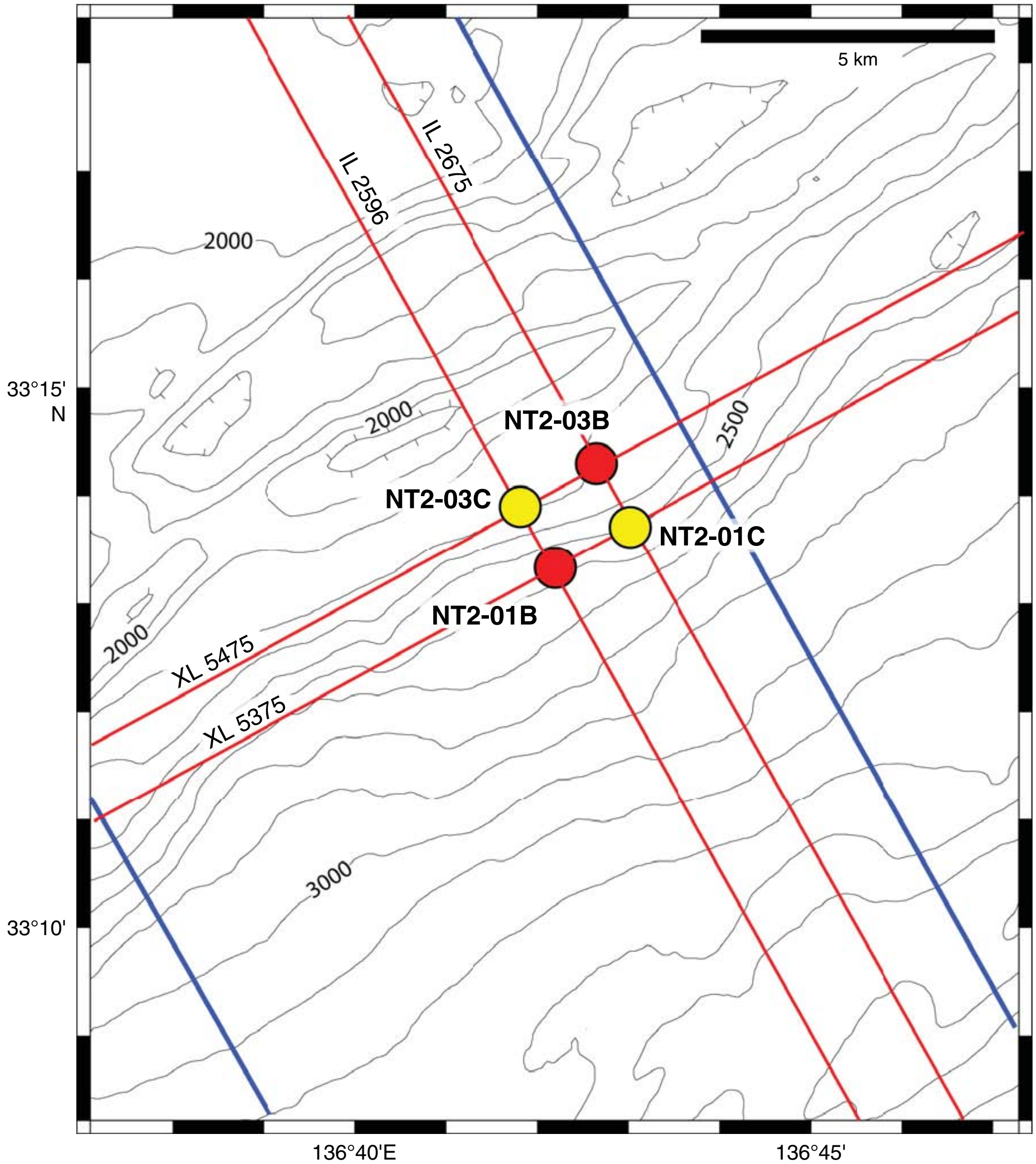


Figure AF24. Inline 2596.

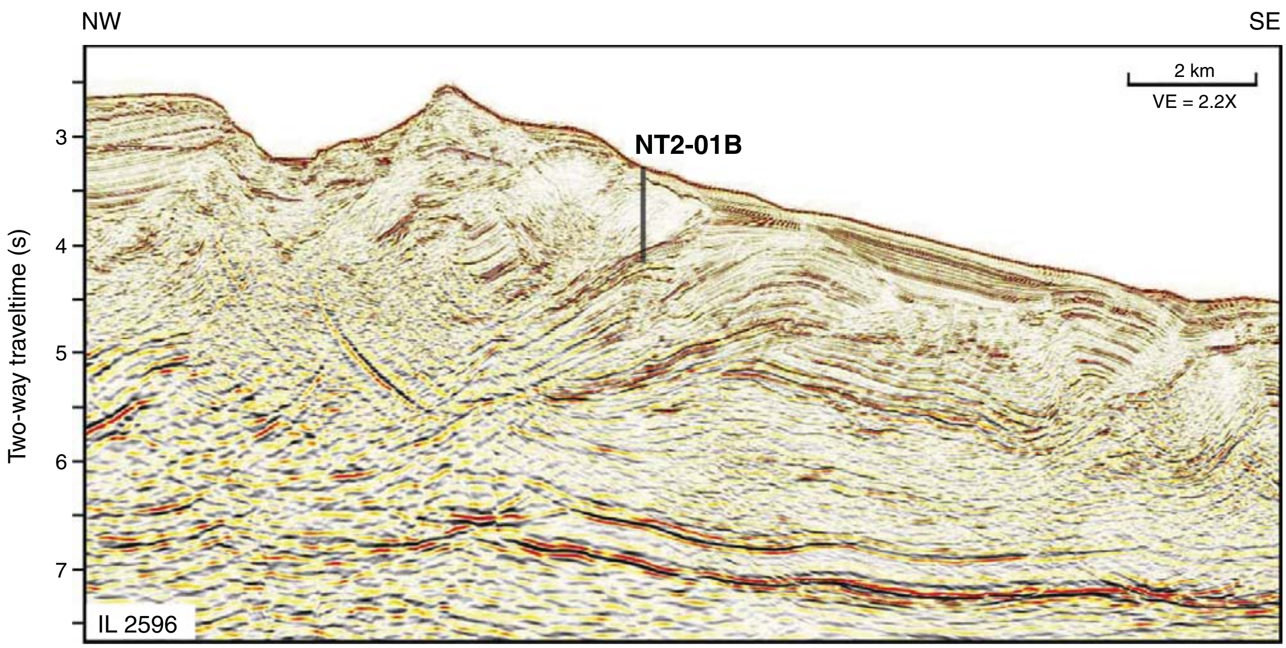


Figure AF25. Inline 2596.

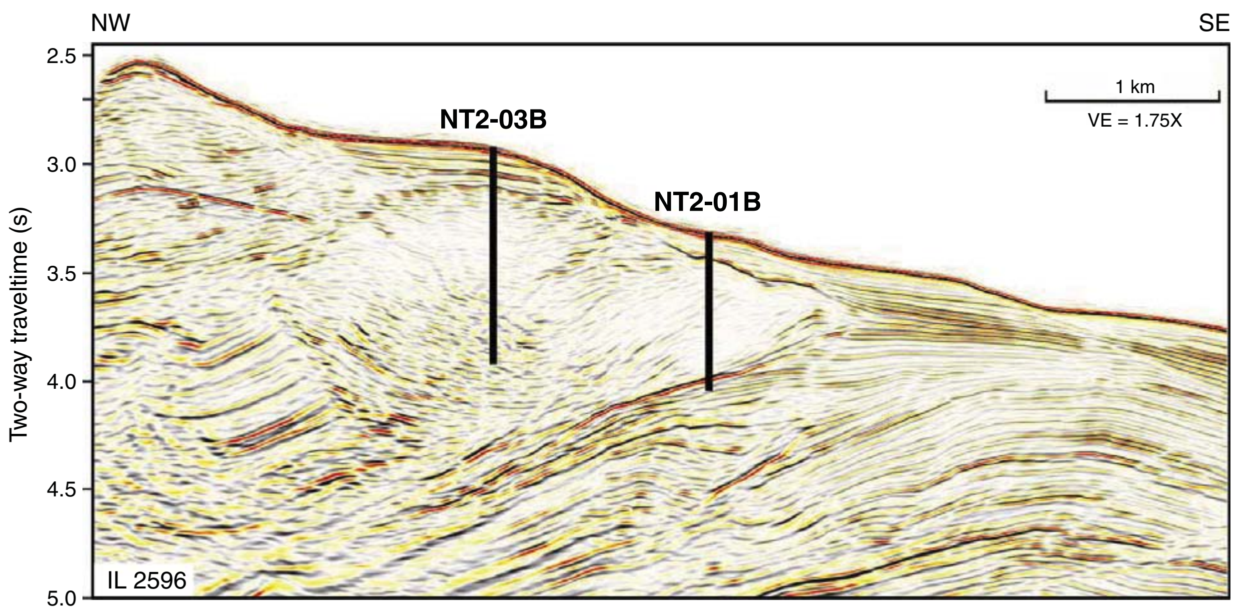


Figure AF26. Crossline 5375.

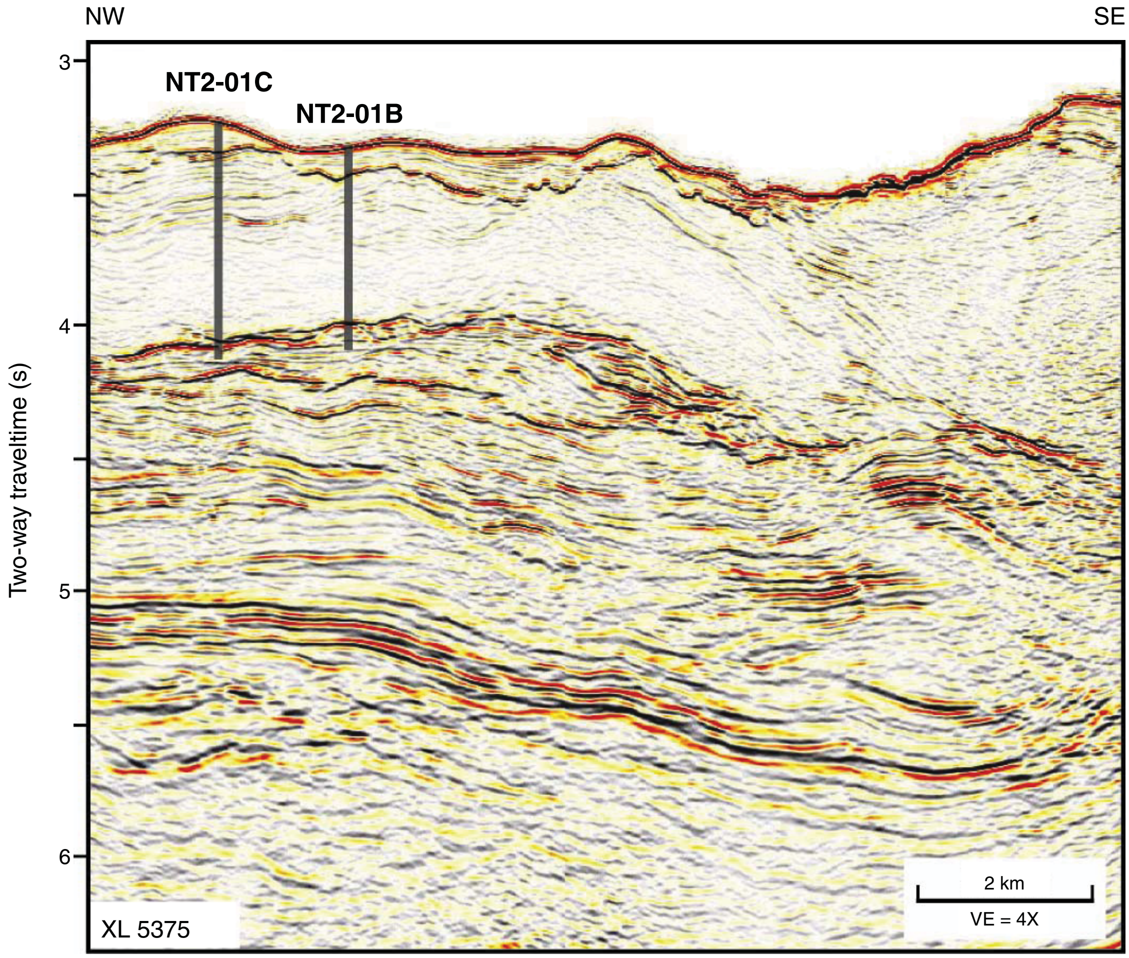


Figure AF27. Inline 2675.

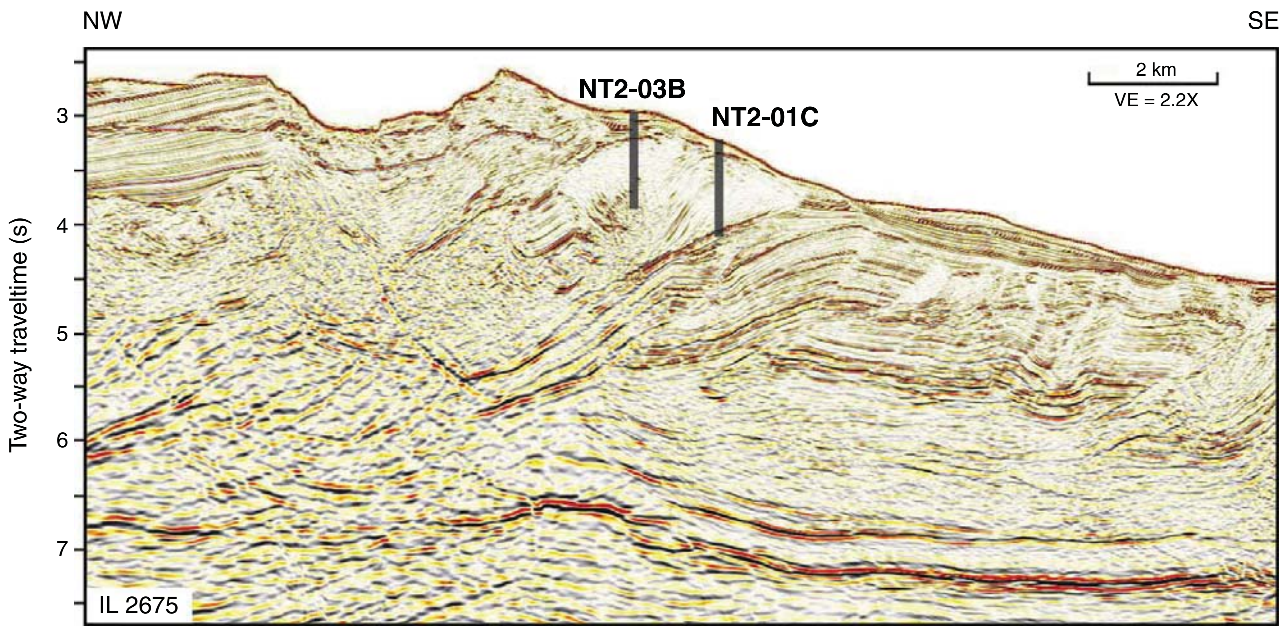


Figure AF28. Inline 2675.

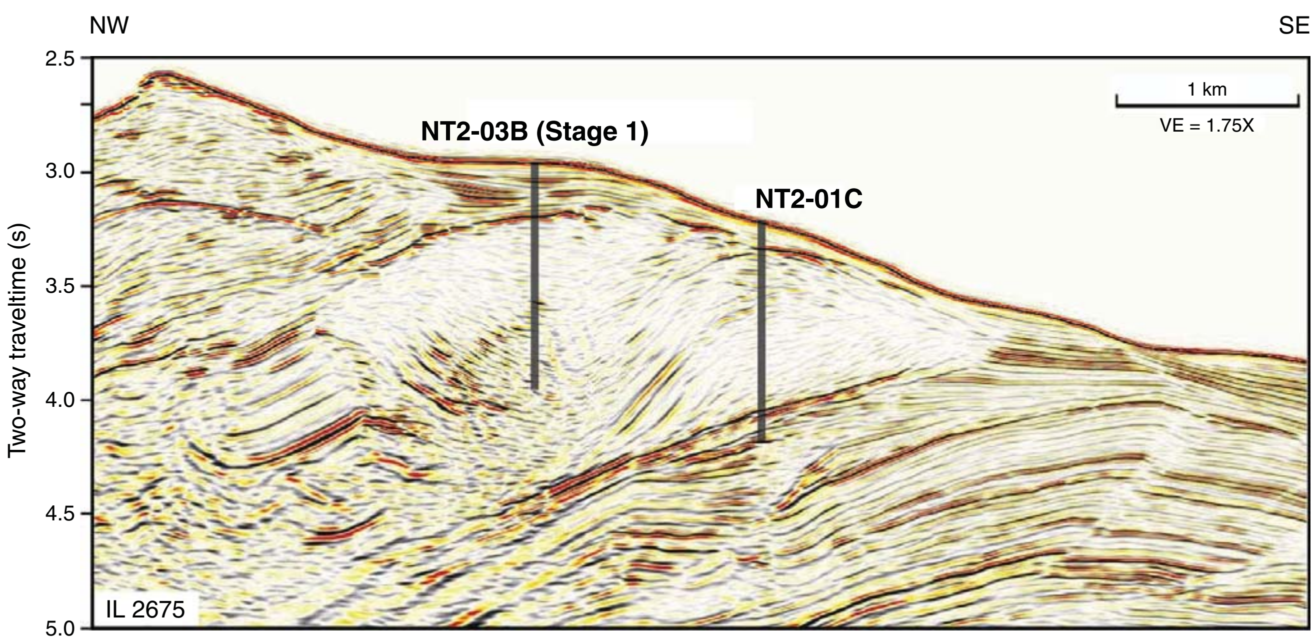


Figure AF29. Crossline 5475.

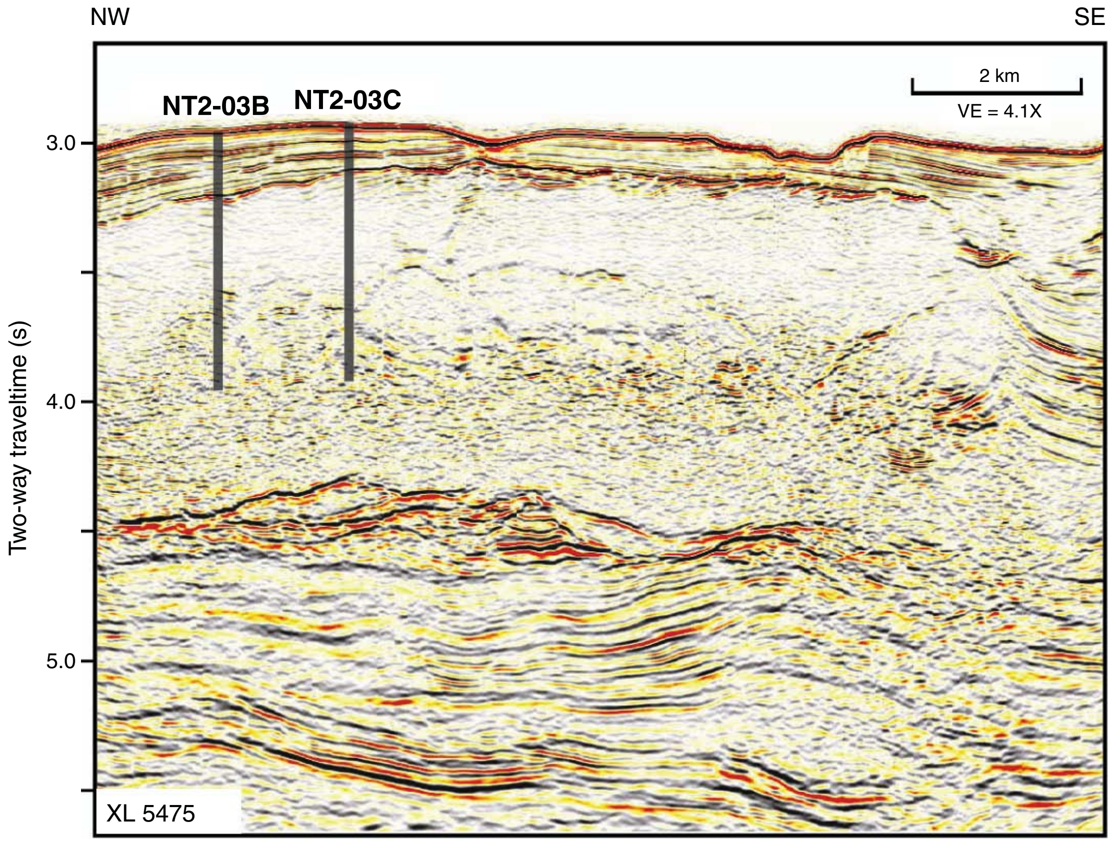


Figure AF30. Track map, Site NT3-01.

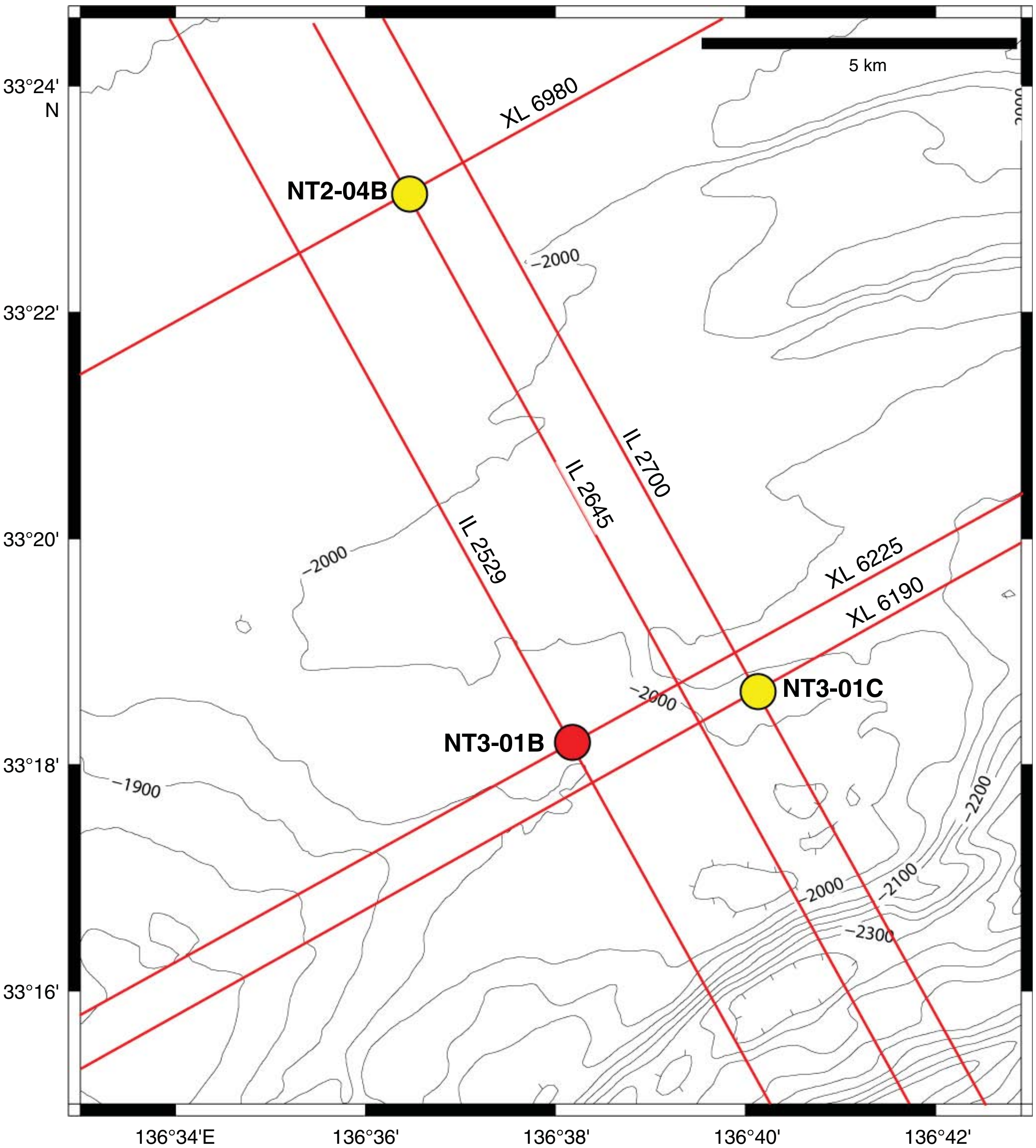


Figure AF31. Inline 2645.

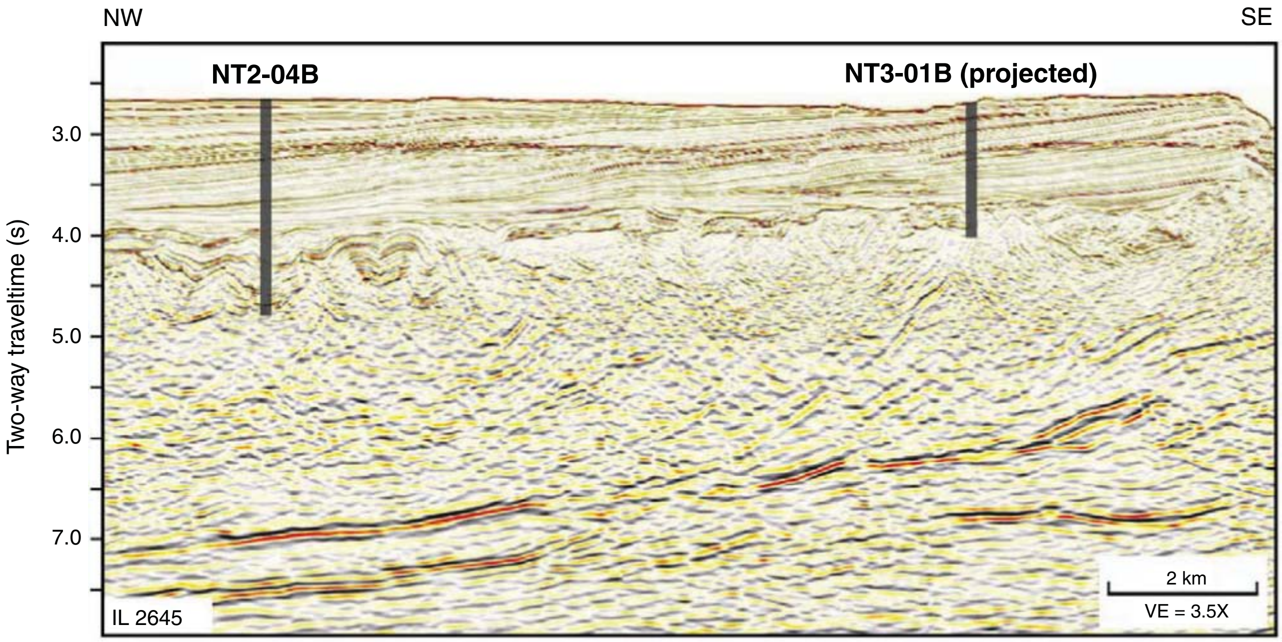


Figure AF32. Inline 2645.

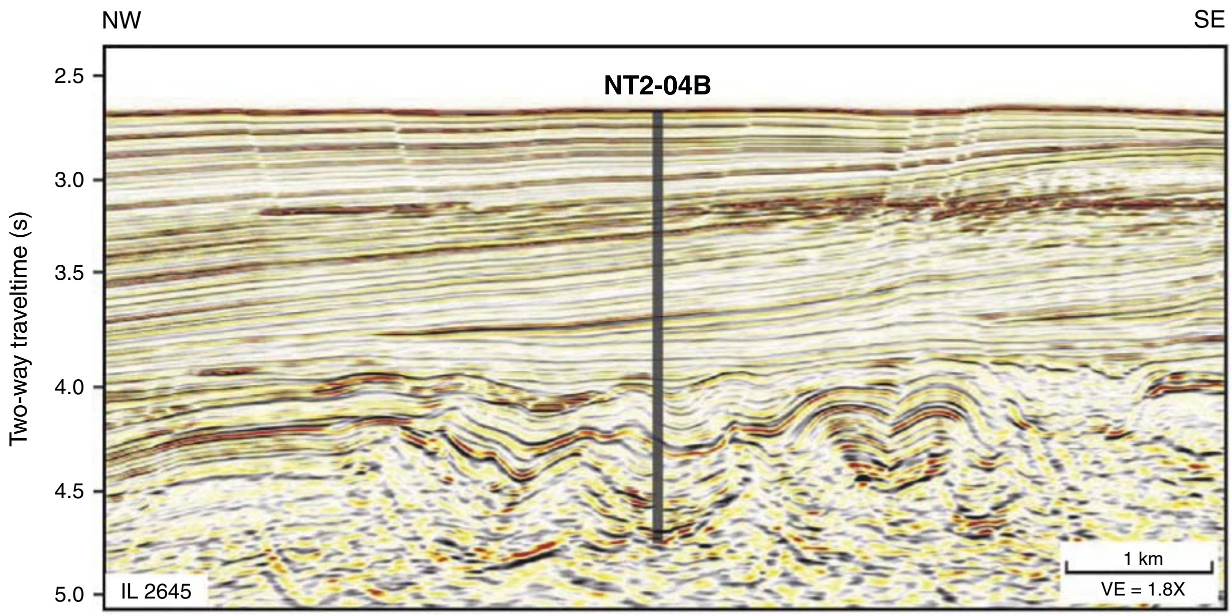


Figure AF33. Crossline 6980.

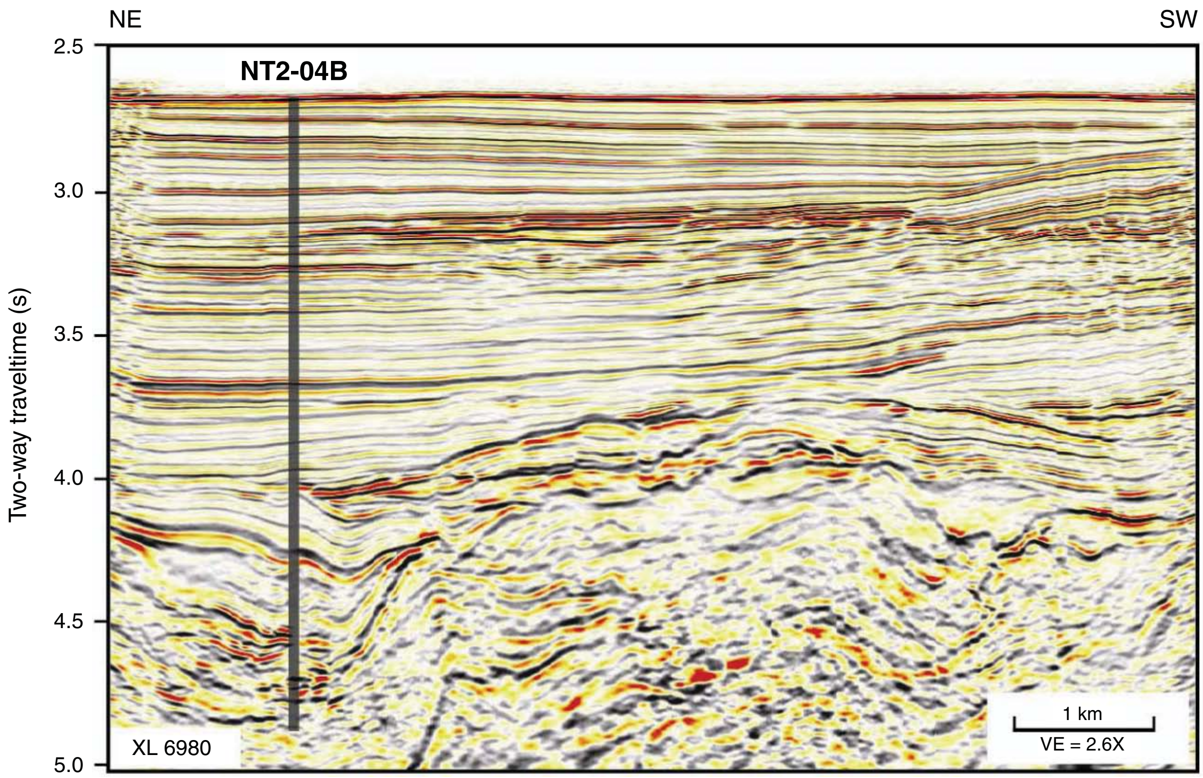


Figure AF34. Inline 2529.

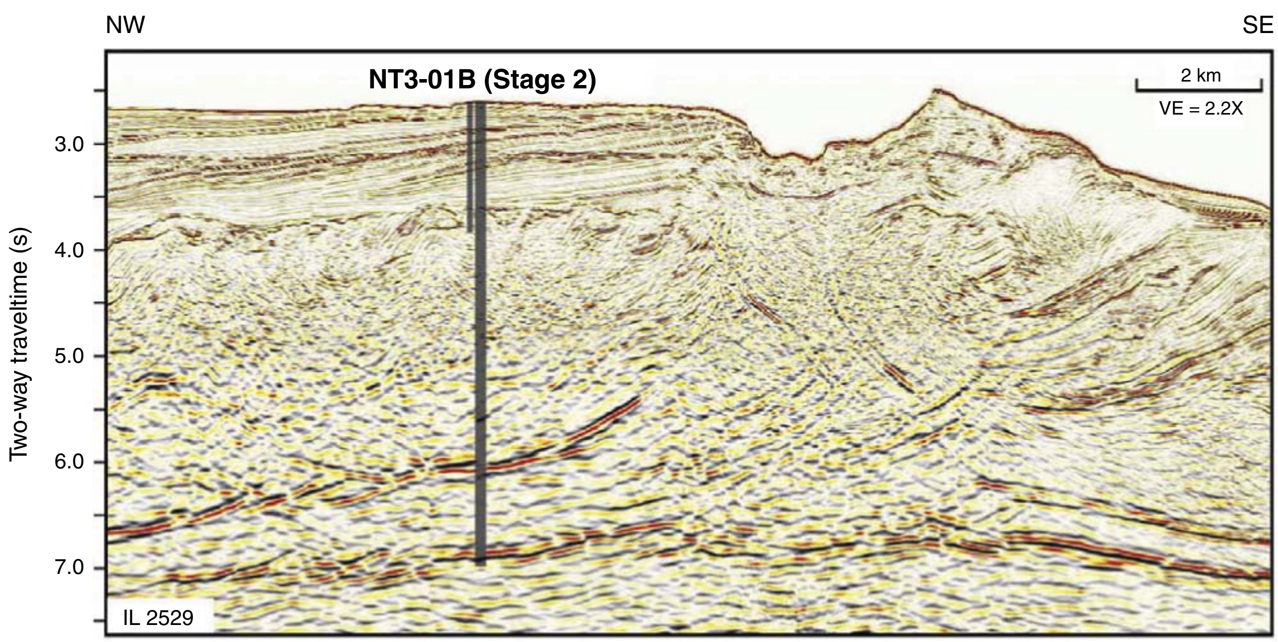


Figure AF35. Inline 2529.

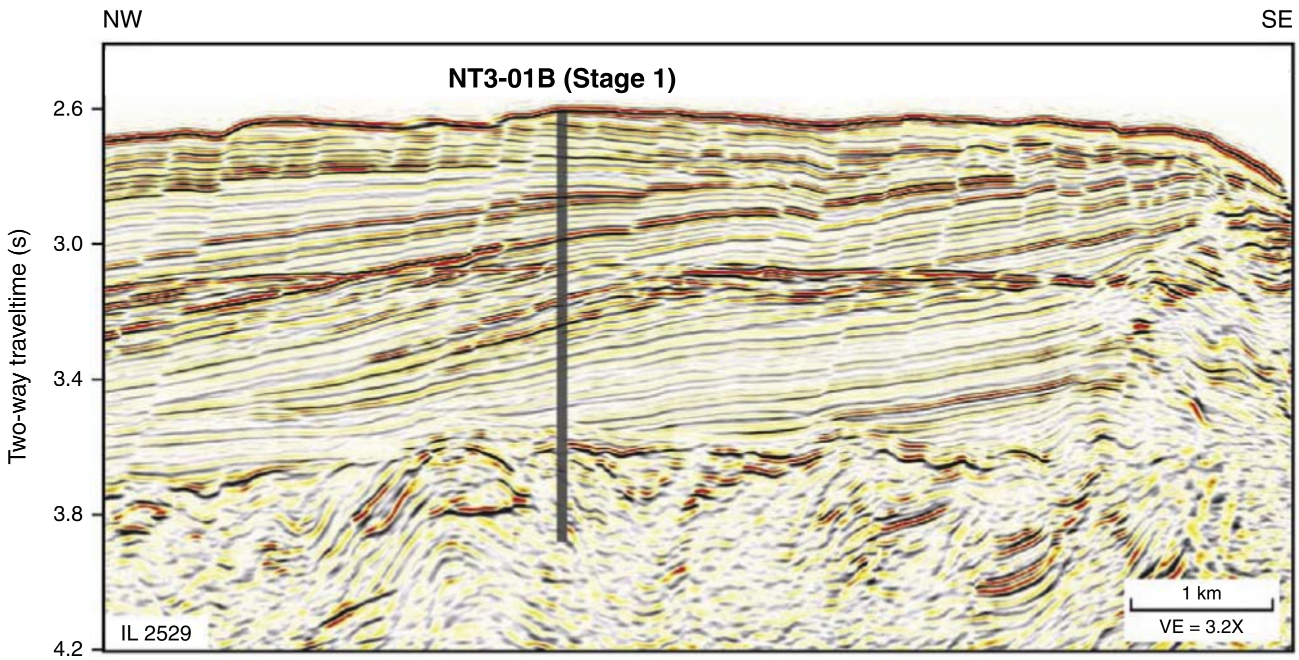


Figure AF36. Crossline 6225.

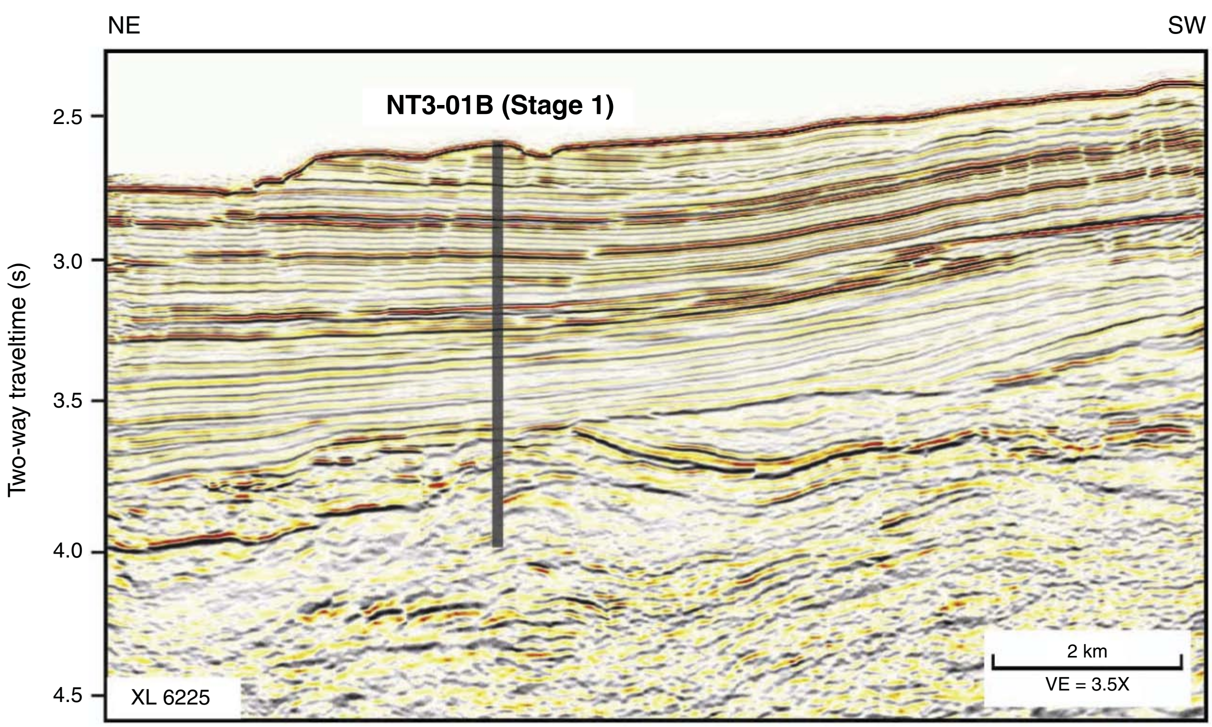


Figure AF37. Inline 2700.

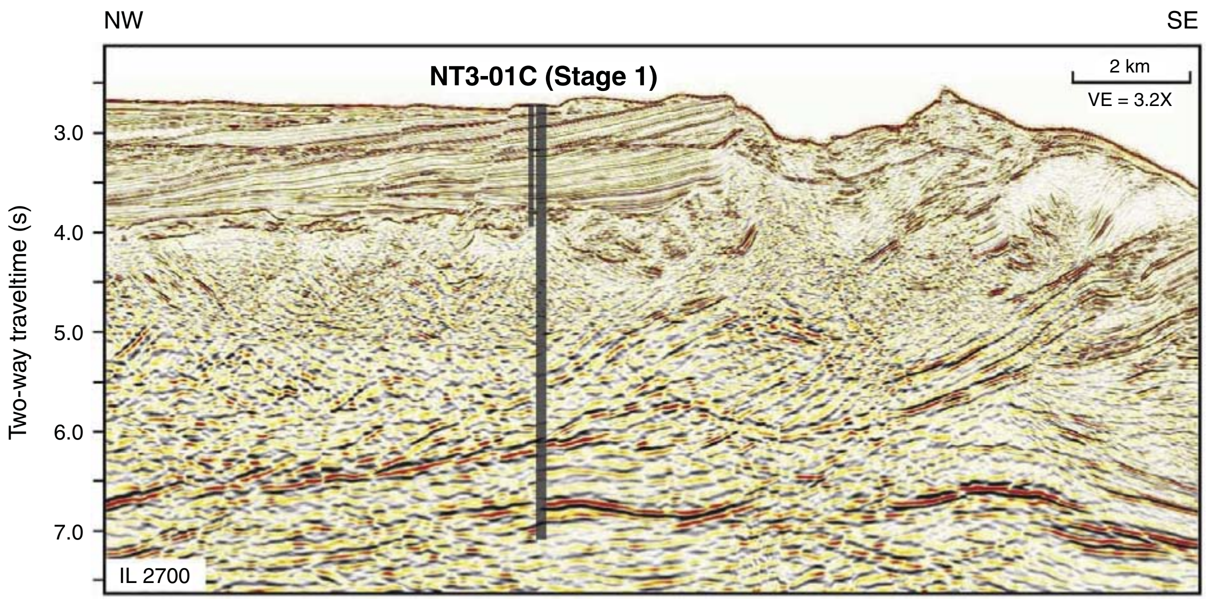


Figure AF38. Inline 2700.

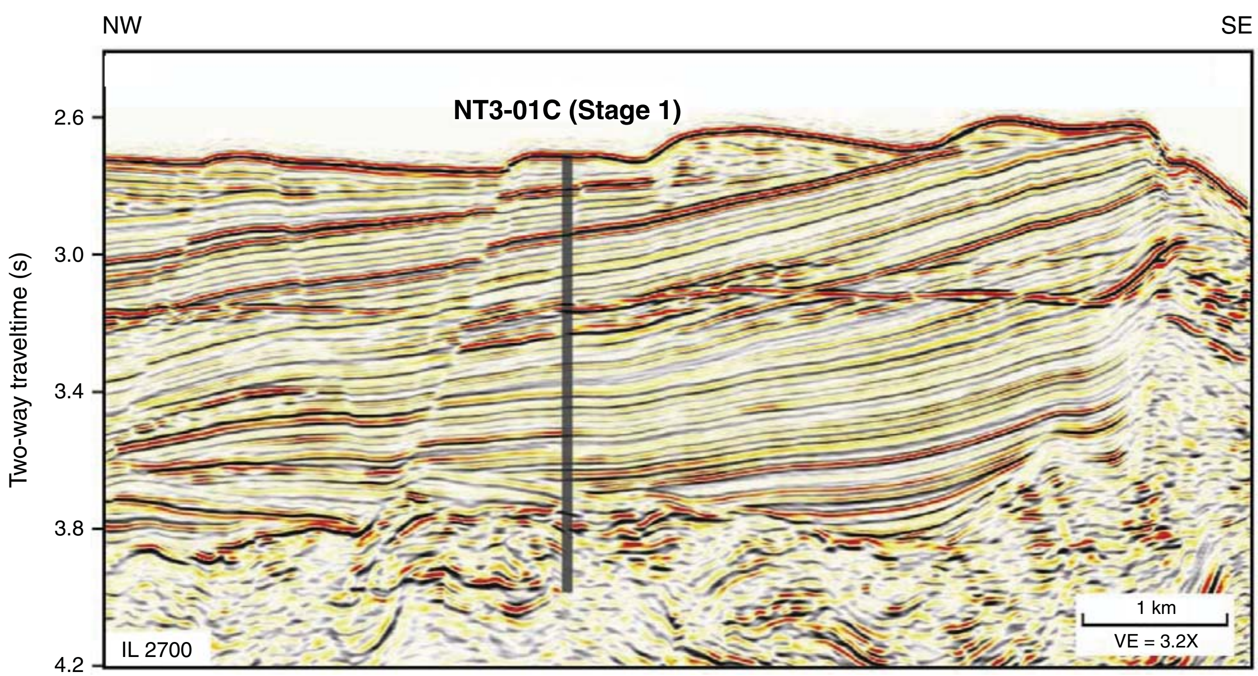
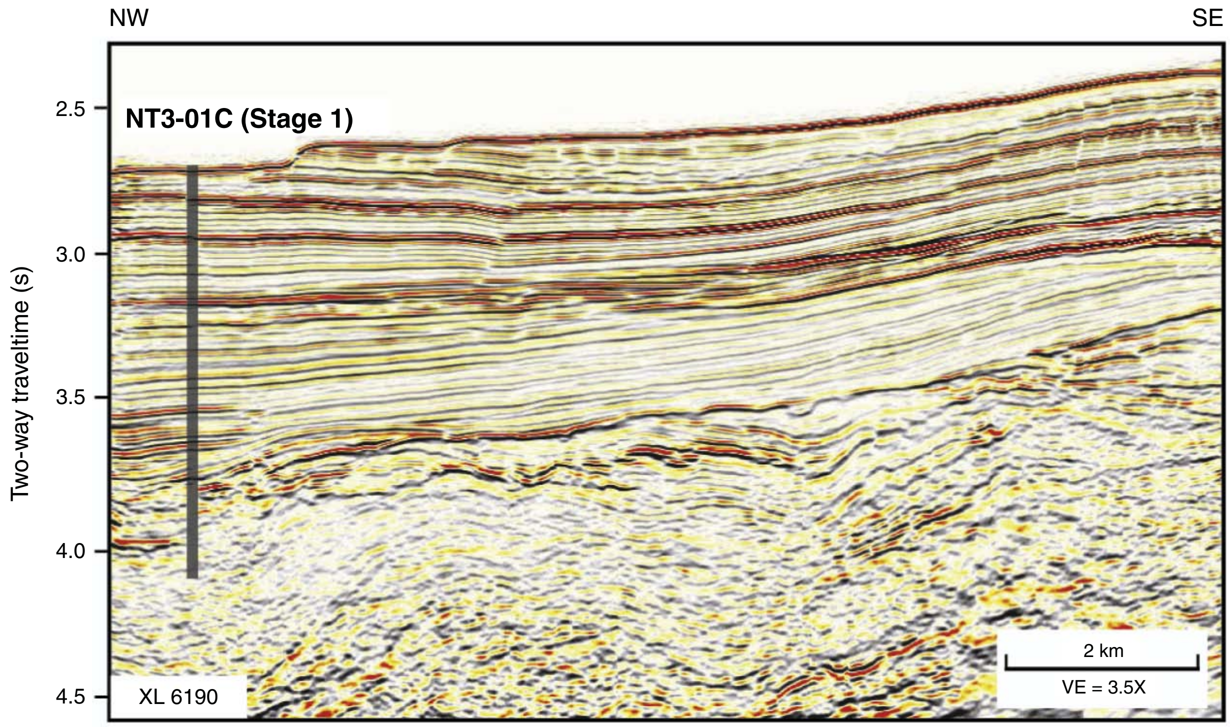


Figure AF39. Crossline 6190.



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