

Expedition 338 Mini-Prospectus

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NanTroSEIZE Stage 3 - Plate Boundary Deep Riser – 2

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Summary of Planned Operations

At the time of this writing, NanTroSEIZE Stage 3 drilling is planned to extend riser Hole C0002F (Figure 1), begun on Expedition 326 in 2010, from 856 meters below the sea floor (mbsf) to ~ 3600 mbsf (Figures 2 and 3) over a four month period beginning in late September 2012 and ending in end of January 2013. This would access the deep interior of the Miocene accretionary prism, penetrating a unique, never-before sampled, tectonic environment.

IODP Site C0002 is the deep centerpiece of the NanTroSEIZE project, intended to access the plate interface fault system at a location where it is believed to be capable of seismogenic locking and slip, and to have slipped coseismically in the 1944 Tonankai earthquake (e.g. Ichinose et al., 2003). This zone also coincides with the location where a cluster of very low frequency (VLF) seismic events occurred in 2004-5 (Ito and Obara, 2006) and the first tectonic tremor recorded in an accretionary prism setting has been found (Obana and Kodaira, 2009). The primary targets include both the basal décollement and the reflector known as the “mega-splay fault” (Tobin and Kinoshita, 2006). The mega-splay fault reflection lies at an estimated depth of 5200 mbsf and the top of subducting basement at ~6800 mbsf (Figure 2). The planned ultimate target depth for this site is 7000 mbsf, to be reached in future operations.

Operations in 2012 for Expedition 338 include:

- Riser drilling with continuous cuttings recovery and mud gas analysis from ~856 mbsf to total achieved depth (TD) for this phase of drilling, currently planned for ~ 3600 mbsf;
- Coring of 50 meters at each casing TD (approximately 2250-2300 mbsf and 3550-3600 mbsf) in intervals deep within the inner wedge accretionary complex (more coring will be performed if the schedule permits);
- An extensive suite of LWD and wireline logging, downhole stress, pore pressure, permeability tests and a planned zero-offset vertical seismic profile.

Further background information about the NanTroSEIZE transect and the goals for ultradeep drilling can be found in Tobin and Kinoshita (2006), Tobin et al. (2009), Kinoshita et al. (2009), Moore et al. (2009), Exp. 319 Scientists, 2010, and Underwood et al., 2010.

Primary plan: Site C0002 Operations and Scientific Measurements

The primary drilling plan for Expedition 338 is to extend Hole C0002F through riser drilling with the drilling vessel *Chikyu* to approximately 3600 mbsf (the actual depth will be determined by drilling conditions and time available). The hole will be suspended at the 13 3/8" casing set point (Figure 2), after casing is installed and cemented into place. On Expedition 326 in 2010, the wellhead was installed and a 20" casing string was cemented in place to 856 mbsf.

The uppermost 1400 mbsf section at Site C0002 was previously logged with a comprehensive LWD program during Expedition 314 (Shipboard Scientific Party, 2009a), and intervals 0-204 mbsf and 475-1057 mbsf were cored during Expedition 315 (S.S.P., 2009b). The Kumano forearc basin sedimentary package composes the interval from 0-940 mbsf, and it is underlain by the "inner wedge" deformed accretionary wedge package. The seismic reflection character of the entire zone from ~ 940 mbsf to the megasplay reflector at ~5200 mbsf exhibits virtually no coherent reflectors indicative of intact stratal packages, in contrast to the outer accretionary wedge seaward of the mega-splay fault system (Figure 2; also see Moore et al., 2009). This seismic character is thought to indicate that the inner wedge is a complexly-deformed zone, perhaps best characterized as a subduction mélange or proto-mélange. The anticipated lithology is Miocene age hemipelagic mudstones and turbidites with volcanic ash throughout this entire interval. Accordingly, the main research objectives for this interval are to sample the interior of the accretionary complex in the midslope region beneath the Kumano forearc basin with both cores and drill cuttings, to perform downhole stress orientation/magnitude, pore pressure, permeability, and collect an extensive suite of LWD and wireline logs to characterize the formation.

The interval from 856 mbsf to TD will be drilled with continuous LWD resistivity, gamma, and downhole fluid pressure data recording, except for intervals to be cored. During this riser drilling, mud return will allow for a comprehensive program of drill cuttings and mud gas analysis, as was performed at Site C0009 and described in the Expedition 319 Summary (Exp. 319 Scientists, 2010). Coring (100 m) is also planned to sample the inner wedge, restricted to two specific intervals of ~50 m each, currently tentatively planned for around 2250 – 2300 mbsf and 3550 – 3600 mbsf. *In situ* minimum principal stress, pore fluid pressure, and permeability will be measured using a downhole formation tester (MDT tool). Plans are being developed for a vertical

seismic profile (zero offset) to elucidate the seismic velocity structure of the inner prism and plate boundary fault system below the borehole.

Site C0002 drilling will therefore access the interior of the landward region of an active accretionary prism for the first time, testing hypotheses for the transition from aseismic prism growth to a strong hanging wall regime defining the outer edge of the geodetically-locked or partially-locked seismogenic plate boundary. Additionally, it will shed light on the nature of prism formation and evolution. At the end of this program, the borehole will be suspended for re-entry and further deepening to the planned plate boundary target during the 2013 – 2014 IODP riser drilling season.

Contingency Operational Options

The details of possible operational priorities or contingencies will be determined by the Co-Chief scientists (Brand Dugan, Kyu Kanagawa, Gregory Moore, and Michael Strasser), EPM's and OSI's; however, current preliminary discussion among CPS includes:

- Installation of riserless permanent observatory at Site C0010,
- Further deepening the hole beyond 3600 mbsf
- Collecting a more extensive suite of core samples
- Installation of temporary borehole monitoring package at Site C0009
- More extensive logging at Site C0002

Discussions with the CDEX Operation Group on including these options and subsequent revision of the operational drilling plan, including time estimates, will continue.

Scientific Staffing Needs

Scientists with interest and expertise in accretionary complex evolution, state of stress in a plate boundary setting, physical and hydrological properties and their evolution, pore fluid properties and processes, core-log-seismic integration (CLSI) in structurally-complex settings, and deep subsurface biology are invited to apply. A shipboard party size of ~13 scientists at a time for each of two approximately 8 week periods is anticipated, making ~ 26 scientists in total. Shipboard duties will likely include sedimentology/lithostratigraphy, micropaleontology, structural geology, physical properties and *in situ* stress, log and CLSI analysis, paleomagnetism, microbiology, and analysis of porewater and gas geochemistry (organic and inorganic).

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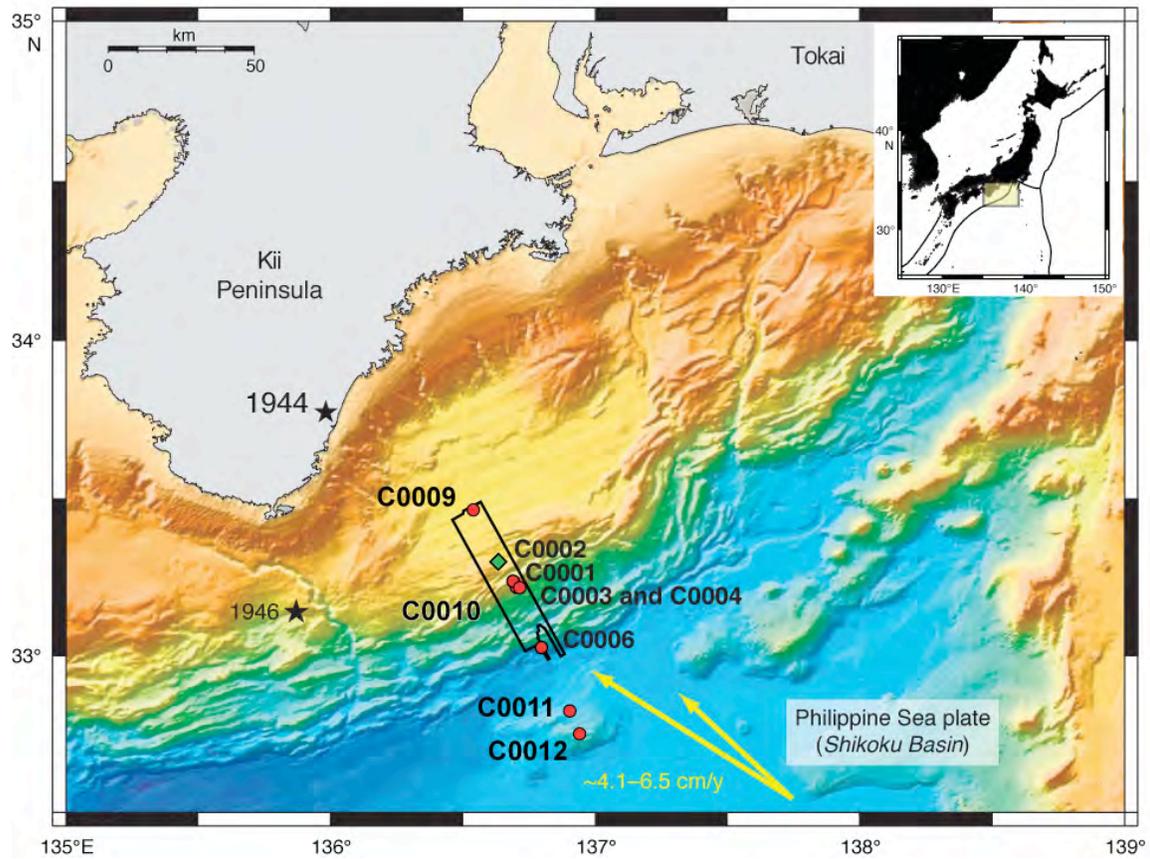


Figure 1. Map of NanTroSEIZE region, with all Stage 1 & 2 drilled sites indicated. The box represents the region with 3D seismic data (Green Square indicates Exp. 338 Site, Red Circles, Stage 1 & 2 Sites).

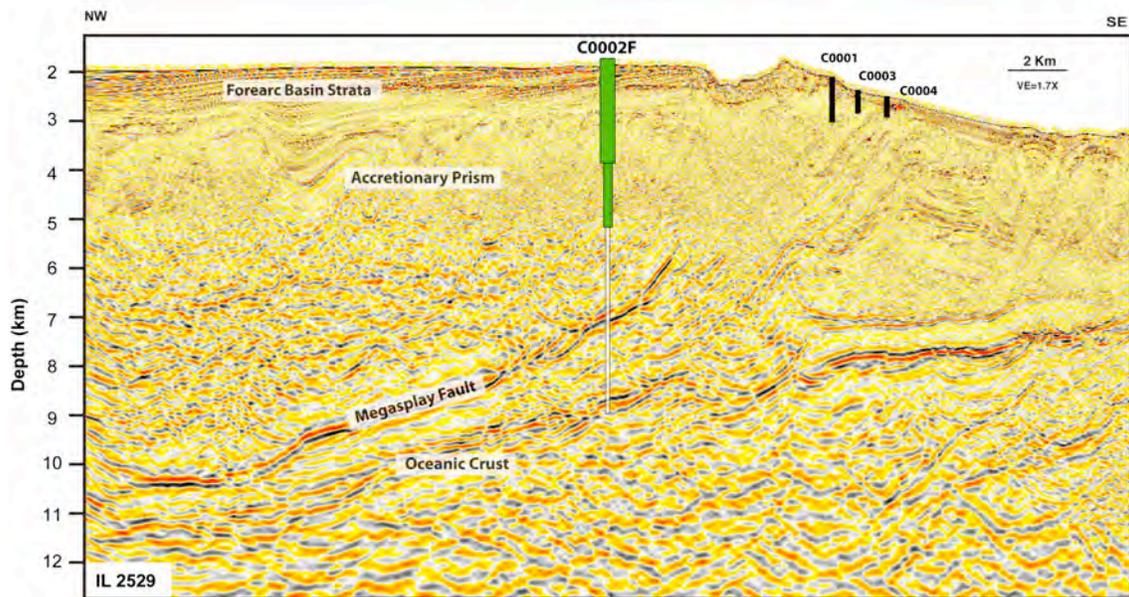


Figure 2. InLine 2529 extracted from the 3D seismic volume, showing Hole C0002F, in relation to Stage 1 Sites C0001, C0003 and C0004. The thin white box indicates the ultimate planned total drilling depth of Site C0002 at 7000 mbsf. Green boxes indicate tentatively planned casing set points for 16" and 13-3/8" casing, respectively. The target depth for Exp. 338 is 3600 mbsf, at the planned 13-3/8" casing shoe position.

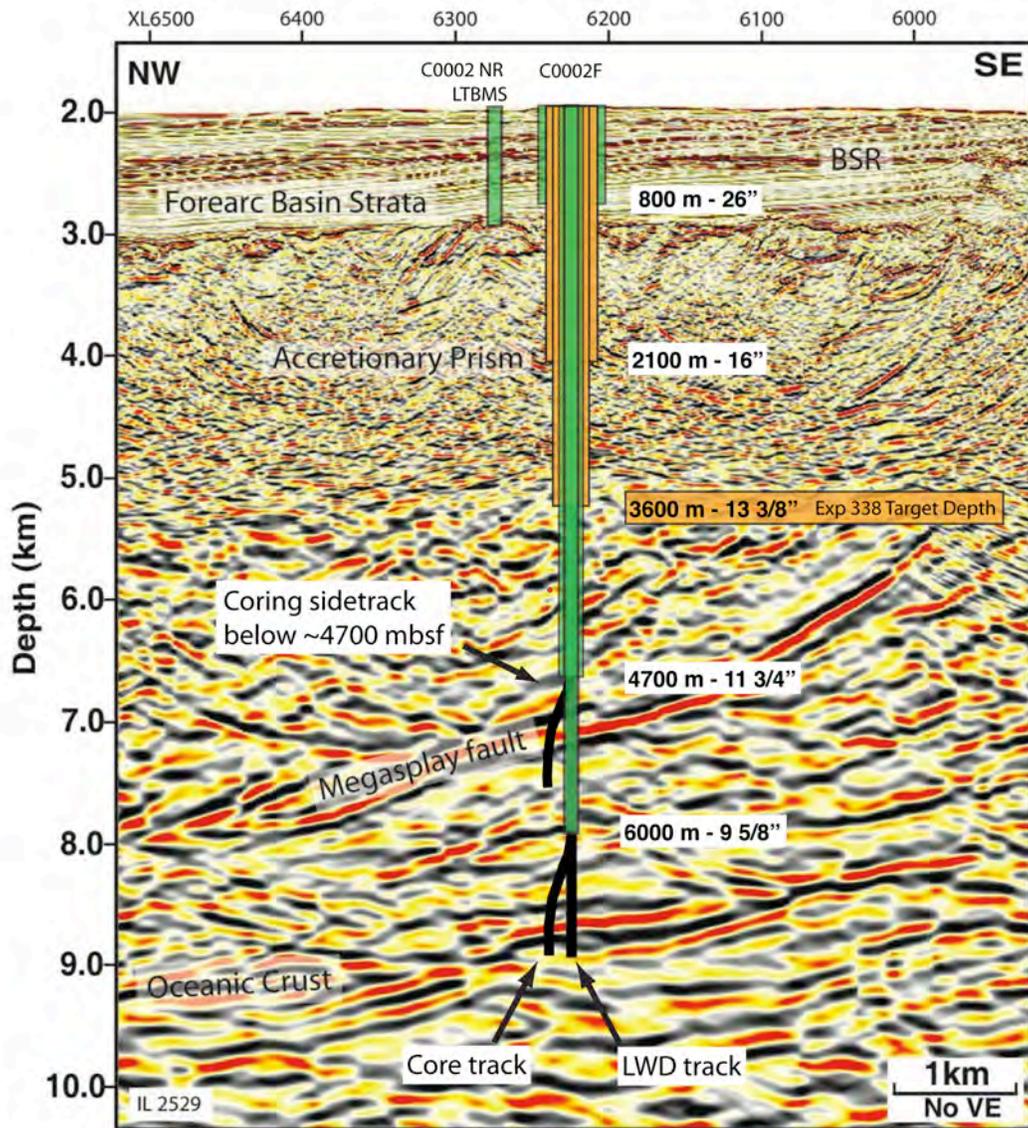


Figure3. A schematic of the planned final configuration of Hole C0002F. The planned TD of IODP Exp. 338 (~3600 mbsf, and casing strings, shown in orange) is indicated in relation to the LTBMS Observatory installed (IODP Exp. 332) in a non-riser hole in the top 1000 m of the formation. Final operations include coring sidetracks planned at the megasplay fault and the plate boundary,