Title: Ancillary Project Letter: Nankai Trough Submarine LandSLIDE history (NanTroSLIDE)

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Keywords: Submarine Landslide, Mass transport deposits, Geohazards, Paleoseismology, Slope basin sedimentary evolution

Area: Nankai Trough, Japan

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Permission to post abstract on IODP Web site: [ ] Yes [ ] No

Abstract: (400 words or less)

This Ancillary Project Letter aims to add one Site (NTS-1A) to the NanTroSEIZE study area to constrain timing, causes and consequences of submarine landslides in one of the best studied accretionary complexes worldwide. It is generally accepted that submarine landslides are leading agents for downslope sediment mass transport and can have catastrophic impact on both offshore infra-structure (e.g. pipelines, cables and platforms) and coastal areas (e.g. landslide-induced tsunamis). Although increasingly investigated within international programs (e.g. IGCP 511, MARGINS, COSTA, STRATAFORM) over the last decade, many open questions remain in relation to trigger mechanisms and timing. To improve our conceptual understanding, quantitative constraints on frequency and magnitude of submarine landslides on relevant timescales are key requirements and need to be related to associated triggering factors and slope failure mechanisms.

On the basis of new 3D seismic data interpretation in the NanTroSEIZE study area, we have identified an ideally suited slope basin sedimentary succession that is composed of stacked Pleistocene-to-recent mass transport deposits (MTDs) that includes one exceptionally large MTD up to 150m in thickness. A 350m thick succession, comprising the distal part of the mega deposit, could be completely drilled by APC/XCB (or HPCS/ESCS) within 3 days before, during or after any of the upcoming NanTroSEIZE operations.
We expect to catalog a detailed submarine landslide event history along with clues on the depositional dynamics of each MTD as they relate to tsunamigenic potential. In conjunction with 3D seismic interpretation we will be able to constrain scales and landslide magnitude. The results obtained will be interpreted in terms of short-term trigger mechanisms and long-term pre-conditioning factors by correlating the magnitudes and frequencies of MTDs to the seismicity and tectonic evolution of the margin. Additionally, data from nearby NanTroSEIZE drill sites are expected to reveal quantitative constraints on slope stability conditions and submarine landslides initiation. In combination, the available data set will allow us to establish a better physical understanding of tectonic processes and slope failures, to gain a general understanding of failure-related sedimentation patterns and the significance of large episodic mass transport events. Ultimately, this could help us to assess the tsunamigenic potential of submarine landslides. We thus expect this proposed project to become an important case study providing the base to improve our conceptual understanding of causes and consequences of submarine landslides.
Scientific Objectives: (250 words or less)

The primary goals of drilling the proposed site (NTS-1A) are:
(i) To establish a well-dated Pleistocene-to-recent mass-movement event stratigraphy
(ii) To sample the distal part of an exceptionally thick MTD for analyzing its rheological behavior to constrain sliding dynamics and tsunamigenic potential

This aims at providing answers to following questions:
1) What is the frequency of submarine landslides
2) How are MTDs and earthquakes related and can we use the MTD-inventory to interpret paleoseismology
3) What controls type, size and magnitude of turbidites and MTDs and how do they change through time?
4) What are the dynamics of large submarine landslides and can we infer their tsunamigenic potential?

By addressing these focused key questions, we aim to isolate tectonic processes influencing magnitude and occurrence of submarine landslides along active subduction zone margins and to understand their potential for triggering catastrophic consequences both in terms of hazard (tsunamigenic landslides) and of sediment mass-transfer and margin evolution.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

None

Proposed Sites:

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Position</th>
<th>Water Depth (m)</th>
<th>Penetration (m)</th>
<th>Brief Site-specific Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTS-1A</td>
<td>136 deg 40.8888’ E 33 deg 09.4195’ N</td>
<td>3100</td>
<td>350</td>
<td>Core and date slope basin sediments and mass transport deposits to constrain submarine landslide history</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td></td>
</tr>
</tbody>
</table>
**Nankai Trough Submarine LandSLIDE history (NanTroSLIDE)**

**Introduction:**
Submarine landslides are of significant interest from many aspects: They represent a major geohazard for offshore infra-structure and can create local, destructive tsunami that pose a threat to coastal structures and populations (Locat and Lee, 2002). In addition, methane emissions from gas hydrate dissociation are believed to occur primarily via the emplacement of submarine slides (e.g. Kennett et al., 2000). Furthermore, they are leading agents in sediment mass-transfer and the stratigraphic evolution of sedimentary basins (Hampton et al., 1996). In active tectonic environments, subaquatic landslide deposits can also be used to make inferences regarding the hazard derived from seismic activity (Strasser et al., 2006; Goldfinger et al., 2003).

Whereas the largest failures are associated with passive margins and volcanic slopes (e.g. Chaytor et al., 2008; Hühnerbach et al., 2004; Moore et al., 1994), submarine accretionary wedges are loci of diffuse slope instability, with a high concentration of generally small mass transport deposits (MTDs) (e.g. McAdoo et al., 2004). However, mega slides can also occur less frequently along the lower slope related to seamount subduction (e.g. von Huene et al., 2008) or in mid-slope regions as large-scale collapses of uplifted structural highs in the hanging wall block of thrust faults (e.g. Cochonat et al., 2002). Such large MTDs have also been identified in outcrops on land and related to the structural evolution of accretionary wedges (e.g. Lucente and Pini, 2008). Although less frequent, such mega events may have catastrophic consequences both in terms of hazards (tsunamigenic landslide) and of sediment mass-transfer and basin evolution.

To date, many landslides have been mapped and imaged in different settings (e.g. Owen et al., 2007) but many open questions remain in relation to trigger mechanisms and timing (Camerlenghi et al., 2007). Many studies suggest earthquake shaking as a likely ultimate trigger mechanism, but long-term factors including tectonic oversteepening, climatic and oceanographic conditions controlling sea level, sedimentation patterns and gas-hydrate stability, as well as margin hydrology and fluid flow regimes have been hypothesized to exert key roles in controlling slope stability conditions. These factors thus may be critical in controlling the occurrence and magnitude of submarine landslide events (Camerlenghi et al., 2007).

To test the different mass transport genesis models, we first of all need a clear quantitative understanding of the frequency and magnitude of submarine landslides on relevant timescales. This can only be achieved by drilling and by appropriate high-resolution stratigraphy and geochronology. Here, we propose drilling and dating a succession of stacked MTDs of different sizes in an active tectonic region, where earthquakes are prevalent. By a focused study we aim to isolate the tectonic processes that cause landslides of different
scales and to understand why some earthquakes cause slope failures and others do not. This will help us to assess the potential of future submarine landslides and their tsunamigenic potential.

IODP Exp. 308 in the Gulf of Mexico successfully demonstrated the key role of drilling in addressing submarine landslides (Flemings et al., 2005). Apart from this case study, the Storegga Slide off Norway (Solheim et al., 2005) and studies using lakes as model oceans (Strasser et al., 2007), we lack quantitative studies relating well-dated MTDs to associated trigger and slope failure mechanisms. Presently, neither the aspect of downslope sediment mass-transfer nor geohazards from submarine landslides are specifically included in the IODP Initial Science Plan (ISP) or only as peripheral objectives. Our proposed study is complementary to the Seismogenic Zone Initiative while addressing submarine geohazards, which are gaining significant societal interest. Furthermore, it is thematically linked to other IODP expeditions and proposals addressing geohazards from submarine slides (e.g. IODP Exp 308, Proposals #557 (Storegga), and #715 (MedSLIDES)), showing that the topic is of importance and interest to the science community and that it tackles new aspects of oceanic geohazards that advance beyond the ISP (Morgan et al., 2008).

**Proposed Project and Scientific objectives:**

We propose to drill and sample a trench slope basin that is characterized by stacked MTDs and is located in the Nankai accretionary prism. We aim to establish the submarine landslide history and to reconstruct transport dynamics of an exceptionally thick MTD that has been identified in 3D seismic data. Core and log data from proposed Site NTS-1A will be integrated with 3D seismic interpretation and data from nearby NanTroSEIZE sites to determine the relation of submarine landslides to the tectonic evolution. By establishing a better physical understanding of tectonic processes and slope failures, we will also gain a general understanding of failure-related sedimentation patterns and the significance of episodic mass transport events. Ultimately, this could help us assess the tsunamigenic potential of tectonic landslides.

Scientific key questions that drilling NTS-1A will address:

1) What is the frequency of submarine landslides?
2) How are MTDs and earthquake related and can we use the MTD-inventory to interpret paleoseismology?
3) What controls type, size and magnitude of turbidites and MTDs and how do they change through time?
4) What are the dynamics of large submarine landslides and can we infer their tsunamigenic potential?

**Relationship to NanTroSEIZE:**

Although geographically located within the NanTroSEIZE study area, we address exclusive scientific objectives not covered within the main NanTroSEIZE priorities (summary in Tobin and Kinoshita, 2006).
Drilling NTS-1A will also add invaluable new information on the regional litho- and chronostratigraphy. Hence, it will contribute to the general understanding of accretionary prism growth and associated sedimentation when integrated with other NanTroSEIZE drilling results. Similarly, data from NanTroSEIZE drill sites will allow studying slope stability conditions and submarine landslide initiation. Future integrative research will then relate the MTD stratigraphy to quantitative studies testing landslide initiation hypothesis (e.g. seismic shaking, tectonic oversteepening, fluid flow and overpressures, gas hydrate destabilization).

**Proposed Site and Drilling strategy:**

Proposed drill site NTS-1A (Water depth = 3100m) is located on a margin-perpendicular transect 4.5 km to the SW of the NanTroSEIZE drilling transect (Fig. 1). It is located 5 km SSW of Site C0008 that drilled into a small slope basin seaward of the mega splay fault (Kimura et al., 2008). C0008 preliminary results show the potential of using Late Pliocene-to-Early Pleistocene MTDs to reconstruct slope failure activity related to mega splay fault movements (Strasser et al., 2008). Apart from the deepest section, Site C0008 lacks clear evidence for MTDs, potentially due to a significant hiatus in its upper part, suggesting erosion or non-deposition likely related to a prominent slope collapse structure seaward of the mega splay fault (Kimura et al., 2008).
al., 2008). On the basis of new 3D seismic data interpretation we have identified a lower slope basin that (i) better represents the depocenter for downslope mass transport, (ii) is clearly characterized by stacked MTDs, as seismically imaged by acoustically transparent to chaotic bodies with ponded geometries (Fig.1), and (iii) includes a large, up to 150m thick MTD. We propose drilling at a location where the MTD bodies wedge-out and where basal erosion is minimal. Continuous coring to ~350 mbsf will allow for both sampling the MTDs as well as recovering the most complete and longest stratigraphic succession.

From preliminary seismic interpretation it is unclear whether the succession overlying the large MTD is complete or also affected by some erosion. Seismic data do not allow stratigraphic correlation form Site C0008 to NTS-1A, because of the slope collapse structure between the two basins. However, based on onlapping seismic reflections onto the slope collapse structures it appears that the stratigraphic succession is complete at Site NTS-1A (Fig.1). We suppose a suite of small (not seismically imageable) MTDs that may relate to reflection truncations and stratigraphic hiatuses within that overlying package near the slope collapse structure. Only drilling and dating the sedimentary succession will allow us to (i) date and sample MTDs and (ii) to ground-truth the ambiguous seismic interpretation.

We are still actively interpreting seismic data and should have alternate sites before the necessary safety review. 350m APC/XCB (HPCS/ESCS) coring into shallow unconsolidated slope basin sediments is estimated to require ~66h (~2.75 days) (TAMU coring estimator). Since the proposed site is situated within the NanTroSEIZE working area, minimal transit time is required. Alternatively, if ship time might be reduced or transit time would be longer, drilling depth could be reduced to a minimum of 225 mbsf (required time ~1.8 day), which still would allow sampling the big MTD required to meet some of our key objectives.

**Objectives of the Site and interpretation of expected results**

In the following we briefly outline the key objectives, summarize the strategy to achieve them and how results will be integrated to pin down causes and effects of submarine slides along active margins.

1) What is the frequency of submarine landslides?

Standard shipboard analysis (e.g. VCD, PP logging and X-CT images) and post cruise analysis (e.g. anisotropy of magnetic susceptibility or pore water chemistry disequilibrium analysis) will be used to identify MTDs. State-of-the art dating techniques (e.g. bio-, magneto-, tephra-, and stable isotope stratigraphy) will date the sediment above and below MTDs. We expect this to reveal a detailed Pleistocene-to-present landslide event history. This significantly increases the time window of what has been covered so far along active margins (e.g. Holocene event stratigraphy of the Cascadia Subduction zone, Goldfinger et al., 2003).
2) How are MTDs and earthquakes related and can we use MTD-inventory to interpret paleoseismology?
We anticipate that accurate dating (e.g. by $^{210}$Pb and $^{14}$C methods) and MTD characterization will help identify the sedimentary fingerprint of the historical earthquakes (reaching back in time to 684 A.D., Ando 1975). By establishing physical process correlation of failures and earthquakes, the deeper sedimentary record can be used as an unprecedented paleoseismic archive covering the long-term history of subduction zone megathrust earthquakes.

3) What controls type, size and magnitude of turbidites and MTDs and how do they change through time?
Seismic-to-core correlation and seismic stratigraphic mapping of MTDs will be used to constrain the spatial extent and possible source areas for individual MTDs. This will allow for constraining landslide magnitudes in the MTD-event catalogue (see objective 1). The results obtained will then be interpreted in terms of short-term trigger mechanisms and long-term pre-conditioning factors by correlating the magnitudes and frequencies of submarine landslides to the seismicity and tectonic evolution of the margin.

4) What are the dynamics of large submarine landslides and can we infer their tsunamigenic potential?
Tsunami generation is controlled not only by slide geometry (slide volume, area, water depth) but also by slide kinematics (slide acceleration and velocity). Insights obtained through sampling and logging the big MTDs, analyzing its frictional behavior using laboratory deformation experiments aligned with numerical modeling studies, will help constraining sliding dynamics and tsunamigenic potential.

**Summary and Conclusion**
In summary, we expect as a minimum result a detailed submarine landslide history that will provide a solid basis for isolating key tectonic processes influencing initiation of landslide at different scales and for understanding why some earthquakes cause slope failures and others do not. Ultimately, this will yield the means for future quantitative studies testing different landslide initiation mechanisms (e.g. seismic shaking, tectonic oversteepening, fluid flow and overpressures, gas hydrate destabilization).
Furthermore, an exceptionally thick MTD in a slope basin of a submarine accretionary wedge will be cored and sampled for the first time. This will offer new opportunities studying such large landslides. Additionally, it will allow for better interpretation of olistostromes in fossil accretionary wedge outcrops and of seismic data showing similar deposits in other areas (e.g. Mosher et al., 2008; Goldfinger et al., 2000). In conclusion, we expect this proposed project to become an important case study providing the base to improve our conceptual understanding of causes and consequences of submarine landslides.
References:


Morgan, J., Silver E., et al., 2008 Addressing geologic hazards through ocean drilling, workshop report – IODP international workshop – August 2007, Portland, USA.


IODP Site Summary Forms:
Form 1 - General Site Information

Please fill out information in all gray boxes
Revised 7 March 2002

**Section A: Proposal Information**

**Date Form Submitted:**
October 1, 2008

**Ancillary Project Letter:**
Nankai Trough Submarine LandSLIDE history (NanTroSLIDE)

- Establishing the submarine landslide history by APC/XCB core sampling. Focus is to obtain samples for precise age dating of sediment above and below MTDs – Priority 1
- Characterizing depositional dynamics of MTDs by APC/XCB core sampling. Focus is to obtain samples of MTDs for analyzing its rheological behavior to constrain sliding dynamics and tsunamigenic potential – Priority 1

**List Previous Drilling in Area:**
IODP Expedition 314 / 315 / 316 (NanTroSEIZE) drilled nearby Sites C0008, C0004 and C0001 (see site location map in Site Summary Form 6)

**Section B: General Site Information**

**Site Name:**
NTS-1A

**If site is a reoccupation of an old DSDP/ODP Site, Please include former Site #**

**Area or Location:**
Southwestern Nankai Trough of Kumano

**Jurisdiction:**
Within Japanese EEZ

**Distance to Land:**
46 NM

**Water Depth:**
3100 m

**Latitude:**
Deg: 33 N  Min: 9.4195

**Longitude:**
Deg: 136 E  Min: 40.8888

**Coordinates System:**
WGS 84

**Priority of Site:**
Primary: 1  Alt:
### Section C: Operational Information

<table>
<thead>
<tr>
<th>Sediments</th>
<th>Basement</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 m</td>
<td>0 m</td>
</tr>
</tbody>
</table>

**General Lithologies:**

Quaternary hemipelagic sediments intercalated with mass transport deposits

**Coring Plan:** (Specify or check)

APC/XCB (or HPCS/ESCS) to TD at Hole A

1-2-3-APC □ VPC* □ XCB □ MDCB □ PCS □ RCB □ Re-entry □ HRGB

* Systems Currently Under Development

**Wireline Logging Plan:**

<table>
<thead>
<tr>
<th>Standard Tools</th>
<th>Special Tools</th>
<th>LWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutron-Porosity</td>
<td>Borehole Televiewer</td>
<td>Formation Fluid Sampling</td>
</tr>
<tr>
<td>Litho-Density</td>
<td>Nuclear Magnetic Resonance</td>
<td>Borehole Temperature &amp; Pressure</td>
</tr>
<tr>
<td>Gamma Ray</td>
<td>Geochemical</td>
<td>Borehole Seismic</td>
</tr>
<tr>
<td>Resistivity</td>
<td>Side-Wall Core Sampling</td>
<td>Acoustic</td>
</tr>
<tr>
<td>Acoustic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formation Image</td>
<td></td>
<td>Density-Neutron</td>
</tr>
</tbody>
</table>

**Max. Borehole Temp.:**

*Expected value (For Riser Drilling)*

<table>
<thead>
<tr>
<th>Cuttings Sampling Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>from _______ m to _______ m, _______ m intervals</td>
</tr>
<tr>
<td>from _______ m to _______ m, _______ m intervals</td>
</tr>
</tbody>
</table>

*Basic Sampling Intervals: 5m*

**Estimated days:**

- Drilling/Coring: 2.7 days
- Logging: none
- Total On-Site: 2.7

**Future Plan:** None

**Hazards/Weather:**

Please check following List of Potential Hazards

- Shallow Gas
- Hydrocarbon
- Shallow Water Flow
- Abnormal Pressure
- Man-made Objects
- H₂S
- CO₂
- Complicated Seabed Condition
- Soft Seabed
- Currents
- Fractured Zone
- Fault
- High Dip Angle
- High Temperature
- Ice Conditions
- Hydrothermal Activity
- Landslide and Turbidity Current
- Methane Hydrate
- Diapir and Mud Volcano
- High Temperature
- Ice Conditions

What is your Weather window? (Preferable period with the reasons)

October – July (typhoon risk in late August and September)
### IODP Site Summary Forms:

**Form 2 - Site Survey Detail**

Please fill out information in all gray boxes

<table>
<thead>
<tr>
<th>Proposal #: 738-APL</th>
<th>Site #: NTS-1A</th>
<th>Date Form Submitted: October 1, 2008</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Data Type</th>
<th>SSP Requirements</th>
<th>Exists In DB</th>
<th>Details of available data and data that are still to be collected</th>
</tr>
</thead>
</table>
| 1 High resolution seismic reflection | Yes | | Primary Line(s): CDEX 2006 3D InLine 2315 at XLine 4950  
Crossing Lines(s): CDEX 2006 3D XLine 4950at InLine 2315  
Location of Site on line (SP or Time only) |
| 2 Deep Penetration seismic reflection | N/A | | Primary Line(s):  
Crossing Lines(s):  
Location of Site on line (SP or Time only) |
| 3 Seismic Velocity † | Yes | | Stacking velocity and migration velocity from MCS lines.  
OBS data also available |
| 4 Seismic Grid | Yes | | 3D volume acquired in 2006 |
| 5a Refraction (surface) | Yes | | Two-ship COP (max offset 20km) was obtained by JAMSTEC in Sep. 2002 |
| 5b Refraction (near bottom) | Yes | | OBS data by Nakaishi et al., (1997) |
| 6 3.5 kHz | No | | |
| 7 Swath bathymetry | Yes | | Multi-narrow-beam data by JAMSTEC R/V Yokosuka |
| 8a Side-looking sonar (surface) | Yes | | Some data collected using IZANAGI side scan sonar |
| 8b Side-looking sonar (bottom) | No | | |
| 9 Photography or Video | Yes | | Taken by submersibles of JASMEC |
| 10 Heat Flow | Yes | | Obtained from surface ship, submersibles, long-term monitoring, BSR and coring nearby site C0008 |
| 11a Magnetics | Yes | | Compiled map published from AIST, Japan |
| 11b Gravity | Yes | | Compiled map published from AIST, Japan |
| 12 Sediment cores | Yes | | Nearby IODP site C0008 and gravity and piston cores |
| 13 Rock sampling | Yes | | Taken by submersible and ROV |
| 14a Water current data | Yes | | Available on JODC web page (http://www.jodc.go.jp) |
| 14b Ice Conditions | | | |
| 15 OBS microseismicity | | | Being processed now |
| 16 Navigation | Yes | | |
| 17 Other | | | |

**SSP Classification of Site:**

**SSP Watchdog:**

**Date of Last Review:**

**SSP Comments:**

X=required; X*=may be required for specific sites; Y=recommended; Y*=may be recommended for specific sites;  
R=required for re-entry sites; T=required for high temperature environments; † Accurate velocity information is required for holes deeper than 400m.
### IODP Site Summary Forms:

<table>
<thead>
<tr>
<th>Proposal #: 738-APL</th>
<th>Site #: NTS-1A</th>
<th>Date Form Submitted: October 1, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Depth (m): 3100</td>
<td>Sed. Penetration (m): 350</td>
<td>Basement Penetration (m): 0</td>
</tr>
</tbody>
</table>

### Form 3 - Detailed Logging Plan

**Do you need to use the conical side-entry sub (CSES) at this site?**  Yes [ ]  No [x]

**Are high temperatures expected at this site?**  Yes [ ]  No [x]

**Are there any other special requirements for logging at this site?**  Yes [ ]  No [x]

If “Yes” Please describe requirements:

---

What do you estimate the total logging time for this site to be: 0

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Scientific Objective</th>
<th>Relevance (1=high, 3=Low)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutron-Porosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litho-Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gamma Ray</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistivity-Induction</td>
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<td></td>
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<tr>
<td>Acoustic</td>
<td></td>
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</tr>
<tr>
<td>FMS</td>
<td></td>
<td></td>
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<tr>
<td>BHTV</td>
<td></td>
<td></td>
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<tr>
<td>Resistivity-Laterolog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic/Susceptibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density-Neutron (LWD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistivity-Gamma Ray (LWD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: Special tools (CORK, PACKER, VSP, PCS, FWS, WSP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For help in determining logging times, please contact the ODP-LDEO Wireline Logging Services group at:

borehole@ldeo.columbia.edu
http://www.ldeo.columbia.edu/BRG/brg_home.html
Phone/Fax: (914) 365-8674 / (914) 365-3182

**Note:** Sites with greater than 400 m of penetration or significant basement penetration require deployment of standard toolstrings.
### IODP Site Summary Forms:

Please fill out information in all gray boxes

<table>
<thead>
<tr>
<th>Proposal #: 738-APL</th>
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</tr>
</thead>
</table>

1. **Summary of Operations at site:**
   - (Example: Triple-APC to refusal, XCB 10 m into basement, log as shown on page 3.)
   - APC (or HPCS) to refusal, then XCB (or ESCS) to 350 m.

2. **Based on Previous DSDP/ODP drilling, list all hydrocarbon occurrences of greater than background levels. Give nature of show, age and depth of rock:**
   - IODP conducted drilling at nearby Site C0008 in 2008. No safety problems encountered.

3. **From Available information, list all commercial drilling in this area that produced or yielded significant hydrocarbon shows. Give depths and ages of hydrocarbon-bearing deposits:**
   - None

4. **Are there any indications of gas hydrates at this location?**
   - Yes, MCS profile shows BSRs and IODP drilling at nearby Site C0008 drilled through gas hydrated bearing horizons. No safety problems encountered at Site C0008

5. **Are there reasons to expect hydrocarbon accumulations at this site? Please give details.**
   - No

6. **What “special” precautions will be taken during drilling?**
   - None

7. **What abandonment procedures do you plan to follow?**
   - None

8. **Please list other natural or manmade hazards which may effect ship’s operations: (e.g. ice, currents, cables)**
   - Strong Kuroshio current, typhoon (August – September)

9. **Summary: What do you consider the major risks in drilling at this site?**
   - Current
<table>
<thead>
<tr>
<th>Sub-bottom depth (m)</th>
<th>Key reflectors, Unconformities, faults, etc</th>
<th>Age</th>
<th>Assumed velocity (km/sec)</th>
<th>Lithology</th>
<th>Paleo-environment</th>
<th>Avg. rate of sed. accum. (m/My)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-140 m</td>
<td>Seabed to top of large acoustically chaotic to transparent MTD</td>
<td>Holocene - Pleistocene</td>
<td>1.6 – 2.5</td>
<td>Hemipelagic slope basin sediments intercalated with small MTDs</td>
<td>Accretionary prism - slope basin</td>
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<tr>
<td>140-210 m</td>
<td>Top to base of large acoustically chaotic to transparent MTD</td>
<td>Pleistocene</td>
<td>1.6 – 2.5</td>
<td>Mass Transport Deposit</td>
<td>Accretionary prism - slope basin</td>
<td></td>
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<tr>
<td>210-350 m</td>
<td>Below base of large acoustically chaotic to transparent MTD</td>
<td>Pleistocene</td>
<td>1.6 – 2.5</td>
<td>Hemipelagic slope basin sediments intercalated with medium seized MTDs</td>
<td>Accretionary prism - slope basin</td>
<td></td>
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</tr>
</tbody>
</table>
Figure Caption - Seismic line:
MTD = Mass Transport deposit. Vertical gray and black lines show location of proposed Site NTS-1A and penetration depths to 350 mbsf (1. Priority target depth) and 225 mbsf (2. priority alternative target depth), respectively.
**List of proponents:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>List of expertise and role in the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHI, Juichiro</td>
<td>Ocean Research Institute, University of Tokyo, Japan</td>
<td>Sedimentation processes, Nankai accretionary prism regional geology</td>
</tr>
<tr>
<td>CAMERLENGHI, Angelo</td>
<td>ICREA and University of Barcelona, Spain</td>
<td>Lithostratigraphy and Sedimentology of submarine landslides</td>
</tr>
<tr>
<td>DUGAN, Brandon</td>
<td>Rice University, Houston, TX, USA</td>
<td>Physical Properties, hydrological modelling, slope stability analyses</td>
</tr>
<tr>
<td>HUHN, Katrin</td>
<td>MARUM, University of Bremen, Germany</td>
<td>Numerical simulation of material transport, submarine landslides, and kinematics and mechanics of accretionary prisms</td>
</tr>
<tr>
<td>KAWAMURA, Kichiro</td>
<td>Fukada Geological Institute, Tokyo, Japan</td>
<td>Sedimentation and tectonics, Slumping on Nankai trench lower slope</td>
</tr>
<tr>
<td>MOORE, Gregory F.</td>
<td>Dept. of Geology &amp; Geophysics, University of Hawaii, USA</td>
<td>Submarine Landscape Evolution, Offshore Geomorphology, Tsunami hazard assessment</td>
</tr>
<tr>
<td>PANIERI, Giuliana</td>
<td>Dept. of Earth and Geo-Environmental Sciences, University of Bologna, Italy</td>
<td>Biotrassigraphy and Isotope geochemistry</td>
</tr>
<tr>
<td>PINI, Gian Andrea</td>
<td>Dept. of Earth and Geo-Environmental Sciences, University of Bologna, Italy</td>
<td>Tectono-sedimentary evolution, structural analyses, comparison with fossil olistostromes</td>
</tr>
<tr>
<td>STRASSER, Michael</td>
<td>MARUM, University of Bremen, Germany</td>
<td>Coordination, Integration of seismic, sedimentology and geotechnical data to study subaquatic landslides</td>
</tr>
<tr>
<td>URGELES, Roger</td>
<td>University of Barcelona, Spain</td>
<td>Geotechnical properties of sediments, slope stability analysis</td>
</tr>
</tbody>
</table>

**BOLD: Lead proponents**