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IODP Proposal Cover Sheet

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☑ New ☐ Revised ☐ Addendum

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Title:	**NanTroSEIZE Drilling and Observatory Phase 3: A Window into the Seismogenic Zone**		
Proponent(s):	**Kiyoshi Suyehiro, Harold Tobin, Eiichiro Araki, Susan Bilek, Tadanori Goto, Pierre Henry, Gaku Kimura, Aitaro Kato, Masa Kinoshita, Chris Marone, Greg Moore, J. Casey Moore, Demian Saffer, Arito Sakaguchi, Masanao Shinohara, Ralph Stephen, Akito Tsutsumi, Kohtaro Ujiie, Kelin Wang**		
Keywords: *(5 or less)*	**Seismogenic zone, fault mechanics, borehole observatory, tsunamigenesis**	Area:	**Southwestern Japan margin**

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Permission to post abstract on iSAS Web site: ☑ Yes ☐ No

Abstract: (*400 words or less)*

The principal goal of NanTroSEIZE is to understand seismogenesis and rupture propagation along subduction plate boundary faults by direct testing of key hypotheses related to the mechanics of subduction megathrusts. **NanTroSEIZE Phase 3 represents the culmination of the Seismogenic Zone Initiative: drilling into, sampling, and monitoring of the subduction zone plate interface at depths of coseismic slip.** This proposal centers on the deepest drilling effort in the NanTroSEIZE project: sampling a single site across the entire plate interface into the top of the subducting Philippine Sea plate. The proposed borehole will penetrate a major splay fault (~4 km bsf) potentially implicated in coseismic slip, as well as the master decollement (~6 km bsf), at a location of shallow large slip during the 1944 Tonankai Mw 8.2 earthquake.

The goal of this proposal is to address two key questions by a combination of logging, coring, down-hole experiments, and long-term monitoring:

(1) What controls the nature of fault slip and its spatial variability (i.e. the updip transition from aseismic to seismogenic slip)?

(2) What processes control temporal changes in slip behavior on a given fault?

Specifically, this proposal is aimed at testing hypotheses explaining controls on unstable slip, and documenting the roles of fault zone state (stress, fluid pressure, fabric) and composition in controlling frictional rheology. Down-hole and monitoring observations, core analyses, and post-cruise laboratory studies will provide direct tests of existing hypothesis for fault zone frictional behavior. One focus of Phase 3 will be on documenting the material properties and ambient conditions at each of the two faults, and comparing results with findings from shallower portions of the plate boundary system sampled during Phases 1 and 2 to rigorously characterize controls on fault slip behavior in an active megathrust system.

Proposed activities include (1) drilling, LWD, and casing of a main hole - with drillstem tests performed at casing set points, (2) creation of a sidetrack coring hole with continuous coring from 4000-6200 mbsf, and (3) well tests in perforated casing and installation of an observatory system for continuous monitoring of pore fluid pressure, temperature, strain, tilt, and seismicity. The borehole observatories, along with surface arrays of measurements, and regional geodetic and seismic monitoring, will provide critical data toward understanding the slip distribution, temporal variability, and controlling mechanisms of seismogenic faulting along the plate boundary system.

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Scientific Objectives: (*250 words or less*)

The scientific objectives of NanTroSEIZE Phase 3 drilling are to use *direct observation* to rigorously evaluate the following hypotheses, which are central to understanding earthquake mechanics along subduction megathrusts:

(1) Systematic, progressive material and state changes control the onset of seismogenic behavior on subduction thrusts; (2) Subduction zone megathrusts are weak faults; (3) Within the seismogenic zone, relative plate motion is primarily accommodated by coseismic frictional slip in a concentrated zone; (4) Physical properties, chemistry, and state of the fault zone change systematically with time throughout the earthquake cycle; and (5) The mega-splay (OOST) thrust fault system slips in discrete events which may include tsunamigenic slip during great earthquakes. These hypotheses will be evaluated by detailed characterization – in fault zones and in the surrounding rock volume – of the lithology, structural geology, and physical properties of the rock; the geochemistry of pore fluids; the microbiological activity; the distribution of temperature, stress, and pore fluid pressure in space and time; the seismicity in the near-borehole environment and downdip; the temporal evolution of the strain field; and the evolution of physical properties in the volume around the borehole.

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

Essentially all technologies to be used are non-standard. These will include, but are not limited to:
Riser-based drilling, LWD suite, DVTP-P, active hydrofracturing tests (wireline packer test), VSP.
A borehole observatory with multi-level packers and perforated intervals, Geodetic (strain/tilt), seismic and hydrologic (P,T) sensors and other instruments will be installed for a long-term borehole observatory.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
NT3-01A	33°17.6'N, 136°38.6'E	1950	6000	200	6200	Study the progressive change in the fault properties by intersecting the splay fault at ~4.5km and the seismogenic fault at 5.8 to 6km depth
NT3-02A	33°12.9'N, 136°27.4'E	2100	6000	200	6200	Alternate site for NT3-01A