IODP Proposal Cover Sheet

835 - Full 2

Japan Trench Tsunamigenesis

Received for: 2016-04-01

Title	Tracking Tsunamigenic Slips Across and Along the Japan Trench (JTRACK): Investigating a new paradigm in tsunamigenic megathrust slip with very deep water drilling using the D/V Chikyu
Proponents	Shuichi Kodaira, Jim Sample, Michael Strasser, Kohtaro Ujiie, Jamie Kirkpatrick, Patrick Fulton, Jim Mori, Demian Saffer, Takehiro Hirose, Weiren Lin, Kelin Wang, Yasu Nakamura, Matt Ikari, Ken Ikehara, Marta Torres, Liz Screaton, Rachel Lauer, Chris Goldfinger, Toshiya Kanamatsu, Paola Vannucchi, Jan Behrmann, Virginia Toy, Achim Kopf, Tim Byrne, Saneatu Saito, Greg Moore, Brian Boston, Hung-Yu (Sonata) Wu, Tsuyoshi Ishikawa, Emily Brodsky, Ryota Hino, Asuka Yamaguchi, Toshiya Fujiwara, Anja Schleicher, Christine Regalla, Kentaro Omura, Marianne Conin
Keywords	Tsunami, Earthquake, Subduction, Paleoseismology, Fault
Area	Japan Trench

Proponent Information

Proponent	Shuichi Kodaira
Affiliation	JAMSTEC-CEAT
Country	Japan

☑ Permission is granted to post the coversheet/site table on www.iodp.org

Abstract

Understanding the huge slip and associated devastating tsunami of the 2011 Tohoku-oki earthquake is a high priority challenge for IODP with important societal impacts. JTRACK investigates spatial and temporal aspects of physical, hydrological, and chemical properties of the fault zone to elucidate key factors that can control large (and small) slip on the megathrust. These results may be used to explain the 2011 earthquake, past tsunamigenic events along the Japan Trench, and possibly other great subduction earthquakes world-wide. Planned drilling includes a variety of investigations targeting the fault zone and associated structures. Geologic studies will focus on structure and physical properties, especially frictional characteristics for components of the input pelagic sediments, such as the abundant smectite recognized during previous drilling of the megathrust. Hydrological and chemical effects in and around the fault zone are largely unknown, but likely contribute to earthquake processes. We plan analyses of interstitial water to evaluate the role of fluids during faulting, along with investigations of the local permeability structure. The evolving stress state following the earthquake will be studied with borehole breakouts and temperature/pressure monitoring in a borehole observatory. JTRACK has the unique opportunity to study fault healing after a large earthquake. The strategy for this proposal consists of two 2-hole transects across the Japan Trench in the region of the shallow plate boundary fault that ruptured in 2011. One transect is an area of large slip (>50 m) and the other of smaller slip (1/3~1/2 of the large slip). Each transect has an Inner trench slope'site mainly targeting the plate boundary fault zone, and an Input'site seaward of the trench as a reference site. The borehole sites have largely independent science objectives and there are few logistical constraints on the order or timing of drilling. This may be advantageous for scheduling since operations can be done during several expeditions of short duration.

Scientific Objectives

Our primal objective is to define spatially-varying physical and chemical properties and conditions of the sediments and fluids of the near-trench megathrust that contribute to huge fault displacements and very large tsunamis. Following recommendations from the IODP Science Evaluation Panel and community input at the JTRACK Workshop (May 17-19, 2014, Tokyo), this proposal focuses on the 2011 Tohoku-oki rupture zone by drilling two transects across the Japan Trench in regions of large and small coseismic slip. We will investigate the detailed geologic structures and rock properties of the fault zone, especially frictional and strength characteristics. Permeability and chemical studies will be used to infer the local hydrological structure and its effect on the earthquake rupture. Combining these observations and using comparisons of similar measurements for areas of high and low slip during the 2011 earthquake, we will try to infer key factors that control the amount of displacement during large earthquakes. In addition, time-dependent observations will be carried out to study fault healing after a large earthquake. These will focus on how the local hydrological and stress conditions change during the few years following the large fault displacement during the earthquake.

Non-standard measurements technology needed to achieve the proposed scientific objectives

835 - Full 2

Proposed Sites (Total proposed sites: 5; pri: 4; alt: 1; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JTNT-02A (Primary)	38.5272 144.1992	7115	520	0	520	Obtain sample and logging data of a reference section on the incoming plate seaward of the small slip area of the 2011 Tohoku earthquake as a baseline for comparison with sediments in the prism, plate-boundary décollement and underthrust section. Investigate the role of fluids in the reference input section with geochemical and physical property data from continuous cores. Measure the stress state in the incoming sediment section from borehole and sediment property measurements.
JTNT-04A (Alternate)	38.5171 144.0254	7300	1080	0	1080	Continuously core the frontal prism, fault zone and subducted plate to oceanic basement in the small slip area of the 2011 Tohoku earthquake to obtain representative fault and surrounding rock samples and logging data for structural analyses and laboratory experiments. Investigate the role of fluids in slip with geochemical and physical property data from continuous cores. Measure the prism stress state from borehole and sediment property measurements. An alternate site of JTNT-01A
JTNT-01A (Primary)	38.552 144.0355	7400	980	0	980	Continuously core the frontal prism, fault zone and subducted plate to oceanic basement in the small slip area of the 2011 Tohoku earthquake to obtain representative fault and surrounding rock samples and logging data for structural analyses and laboratory experiments. Investigate the role of fluids in slip with geochemical and physical property data from continuous cores. Measure the prism stress state from borehole and sediment property measurements.
JTCT-02A (Primary)	37.9267 144.0688	6945	450	0	450	Obtain sample and logging data of a reference section on the incoming plate seaward of the large slip area of the 2011 Tohoku earthquake as a baseline for comparison with sediments in the prism, plate-boundary décollement and underthrust section. Investigate the role of fluids in the reference input section with geochemical and physical property data from continuous cores. Measure the stress state in the incoming sediment section from borehole and sediment property measurements.
JTCT-01A (Primary)	37.9389 143.9135	6930	950	0	950	Continuously core the frontal prism, fault zone and subducted plate to oceanic basement in large slip area of the 2011 Tohoku earthquake to obtain representative fault and surrounding rock samples and logging data for structural analyses and laboratory experiments. Install a long-term fault zone observatory to monitor pore pressure and temperature near the previous JFAST temporary temperature observatory. Investigate the role of fluids in slip with geochemical and physical property data from continuous cores. Measure the prism stress state from borehole and sediment property measurements and long-term observatory monitoring.