

# IODP Proposal Cover Sheet

Japan Trench Paleoseismology

866 - Pre

Title	TRACKing past earthquakes in the sediment record along the Japan Trench: Submarine PaleoSEISmology to test cyclic vs. random behavior of megathrust earthquake recurrence(JTRACK-PaleoSEIS)		
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## Abstract

Our perspective of earthquake maximum magnitude and recurrence is limited by short historical and even shorter instrumental records, which are inadequate to fully characterize the complex and multi-scale seismic behaviour of subduction zones. Studying prehistoric events preserved in the geological record is needed to test the competing hypotheses that great earthquakes have predictable long recurrence intervals (Hypothesis 1) or that such occurrences are random in time (Hypothesis 2).

Shaking of seafloor can trigger sediment remobilization processes, the event-deposits of which are archived in the offshore sedimentary record. Here we propose to fill the gap in long-term records of great earthquakes off NE Japan by studying the temporal and spatial distribution of correlative event-deposits and their provenance that allows for testing their earthquake origin. We propose a multi-coring approach by Mission Specific Platform (MSP) giant-piston coring in 29 isolated and physically separated trench-fill and graben-fill basins along an axis-parallel transect of the Japan Trench. Coring is expected to recover continuous upper Pleistocene-to-Holocene stratigraphic successions comprising event-deposits, for which the detailed stratigraphic fingerprint and spatial-temporal distribution will be analyzed for proxy-evidence of great earthquakes. Sediment resuspension and redeposition related to the 2011 Tohoku-oki earthquake was documented and the respective deposits are preserved in basins, formed by flexural bending of the subducting Pacific plate. These basin are promising study areas for testing earthquake triggering of event-deposits, because the forearc slope is relatively simple, without large canyons, and Pleistocene sedimentation in hadal basins is not much affected by eustatic sealevel changes. Results from conventional coring covering the last ~1500 years of the trench-fill reveal good agreement between the sedimentary record and historical documents. We believe that the potential is high for submarine paleoseismology on longer time scales accessible only by giant-piston coring and drilling.

Our approach will utilize a combination of long, intermediate and short cores to be recovered from boreholes (proposal 835Full), MSP giant piston-coring (this proposal) and conventional coring, respectively. We will apply, further refine and implement new methods in submarine paleoseismology, and aim at establishing multi-proxy fingerprints of recent earthquake-triggered event deposits and investigate how they are preserved in the geological record. The results of this proposal can potentially produce a fascinating record unraveling an earthquake history that is 10 to a 100 times longer than currently available information. This would contribute to a tremendous advance in the understanding of the recurrence pattern of great earthquakes.

## Scientific Objectives

There is a high potential of using turbidites and other sedimentary features to reconstruct a long history of great earthquakes off NE Japan. In combination with proposed D/V Chikyu drilling as proposed in 835Full - Japan Trench Tsunamigenesis, and conventional marine research expeditions, JTRACK-Paleoseismology research objectives are:

Objective 1: Identify the sedimentological, physical, chemical, and biogeochemical proxies of event deposits in the sedimentary archive that allow for confident recognition and dating of past earthquakes (this proposal)

Objective 2: Explore the spatial and temporal distributions of such proxies and investigate how they relate to fault characteristics and rupture areas of great earthquakes across the entire Japan Trench subduction system (this proposal)

Objective 3: Elucidate the long-term recurrence pattern of events similar to 2011 Tohoku earthquake (with Proposal 835Full – Japan Trench Tsunamigenesis)

The resulting earthquake catalogue could be 10-100 times longer than current information on earthquake history. This will help resolve the long-term recurrence pattern of great earthquakes at subduction zone margins, by testing:

(Hypothesis 1) Great earthquakes have quasi-periodic recurrence owing to a seismic supercycle as predicted by a simple elastic rebound model

(Hypothesis 2) Great earthquakes occur randomly in time with a low, but on average, constant probability (Poissonian earthquake model)

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

MSP giant piston coring in deep waters of 7-8 km depth

## Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JTP-01A	38.0085, 144.0057	7553	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-12A	39.0313, 144.2474	7350	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate

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JTP-03A	38.2928, 144.0592	7330	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-13A	39.1865, 144.3161	7060	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-04A	38.2771, 144.1617	7150	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-14A	39.2485, 144.2040	7470	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-05A	38.5807, 144.0910	7575	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-15A	39.4445, 144.2157	7520	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous

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JTP-07A	38.7581, 144.1294	7615	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-16A	39.4280, 144.4673	6810	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-08A	38.7445, 144.2196	7220	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-17A	39.5101, 144.3215	7280	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-09A	38.8653, 144.1499	7630	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes.

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JTP-18A	39.7664, 144.2695	7500	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-10A	38.8358, 144.3448	6980	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-19A	39.7968, 144.3568	7270	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-11A	39.0357, 144.2092	7350	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-20A	39.9010, 144.4199	7280	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.

JTP-21A	40.1160, 144.3330	7570	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-22A	40.3880, 144.4160	7600	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-23A	37.6830, 143.8560	7540	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-24A	37.4000, 143.7170	7810	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-25A	37.1830, 143.6300	7800	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-26A	36.9083, 143.4250	7700	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits,

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JTP-27A	36.9000, 143.4440	7630	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-28A	36.3710, 142.9710	7960	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTP-29A	36.0720, 142.6900	8040	50	0	50	Mission Specific Platform (MSP) giant piston coring to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTCT-03A	38.0225, 144.0368	7180	130	0	130	D/V Chikyu HPSC coring, as proposed in proposal 835Full (Japan Trench Tsunamiogenesis) to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme events will contribute to investigate long-term recurrence pattern of great earthquakes at Japan Trench subduction zone.
JTNT-03A	38.5760, 144.1227	7550	180	0	180	D/V Chikyu HPSC coring (as proposed in 835Full Japan Trench Tsunamiogenesis) to recover a continuous upper Pleistocene-to-Holocene stratigraphic successions comprising sedimentary extreme event deposits, which will be analyzed for proxy-evidence of large earthquakes. To be established history of extreme

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