

IODP Proposal Cover Sheet

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Japan Trench Paleoseismology

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Title	TRACKing past earthquakes in the sediment record along the Japan Trench: Testing and developing submarine Paleoseismology in the deep sea (JTRACK-Paleoseismology)		
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Abstract

Short historical and even shorter instrumental records limit our perspective of earthquake maximum magnitude and recurrence, and thus are inadequate to fully characterize Earth's complex and multi-scale seismic behaviour and its consequences. Examining prehistoric events preserved in the geological record is essential to reconstruct the long-term history of giant earthquakes and to deliver observation data that help to reduce epistemic uncertainties in seismic hazard assessment for long return periods. Submarine paleoseismology is a promising approach to investigate deposits from the deep sea, where earthquakes leave traces preserved in stratigraphic succession. However, at present we lack comprehensive data sets and long-term records that allow for conclusive distinctions between quality and completeness of the paleoseismic archives.

Motivated by the mission to fill the gap in long-term records of giant earthquakes, J-Track Paleoseismology aims at testing and developing submarine paleoseismology in the Japan Trench. We propose a multi-coring approach by Mission Specific Platform giant-piston coring to recover the continuous Upper Pleistocene-to-Holocene stratigraphic successions of trench-fill basins along an axis-parallel transect of the 7-8km deep trench. The cores from 29 proposed sites will be used for multi-method applications to characterize event deposits, for which the detailed stratigraphic expressions and spatio-temporal distribution will be analyzed for proxy-evidence of earthquakes.

Sediment remobilization related to the 2011-Mw-9.0-Tohoku-oki earthquake and the respective deposits are preserved in trench basins, formed by flexural bending of the subducting Pacific plate. These basin are promising study areas for testing event deposits for earthquake triggering, because they are poorly connected for sediment-transport from the shelf, experience high sedimentation rates and low benthos activity (and thus high preservation potential) in the hadal environment. Results from conventional coring covering the last ~1.500 years reveal good agreement between the sedimentary record and historical documents. Subbottom profiles image acoustic reflection pattern consistent with basin-fill successions interbedded by episodic deposition of muddy turbidites, thus defining clear targets for paleoseismologic investigations on longer time scales accessible by IODP coring.

We will apply, further refine and implement new methods in establishing event-stratigraphy in the deep sea and in recognizing giant vs. smaller earthquakes vs. other driving mechanism. The results of this proposal can potentially produce a fascinating record unravelling an earthquake history that is 10 to a 100 times longer than currently available information, along with new constraints on sediment and carbon flux of event-triggered sediment mobilization to a deep-sea trench and its influence on the hadal environment.

Scientific Objectives

There is a high potential of using event stratigraphy of trench-fill sedimentary successions in the Japan Trench to reconstruct a long history of giant earthquakes off NE Japan: The primary research objectives of JTRACK-Paleoseismology are to:

O-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 Mw9-class earthquakes vs. smaller earthquakes vs. other driving mechanism.

O-2: Explore the spatial and temporal distribution of such event-deposits to investigate along-strike and time-dependant variability of sediment sources, transport and deposition processes, and stratigraphic preservation.

O-3: Develop a long-term earthquake record for giant earthquakes.

A secondary complementary objective is to:

O-4: Exploit the spatio-temporal inventory of sedimentary event-stratigraphy towards determining sediment and carbon flux of event-triggered sediment mobilization to a deep-sea trench and its influence on the hadal environment.

O-1 and O-2 are related to the mission of testing and developing submarine paleoseismology to produce robust long-term records as input for addressing O-3 and O-4 in the Japan Trench, as comparison with global examples. To address these objectives we propose IODP Mission Specific Platform giant piston coring to recover the continuous Upper Pleistocene-to-Holocene stratigraphic successions of isolated trench-fill basins along an axis-parallel transect of the 7-8km deep Japan Trench. The cores from 29 proposed sites will be used for multi-method applications to characterize event-deposits, for which the detailed stratigraphic expressions and spatio-temporal distribution will be analyzed for proxy-evidence of earthquakes.

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

Mission Specific Platform giant piston coring in deep waters of 7-8 km depth

Proposed Sites (Total proposed sites: 29; pri: 29; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JTPS-01A (Primary)	36.07202 142.73503	8030	40	0	40	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.
JTPS-02A (Primary)	36.10118 142.75813	8000	40	0	40	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.
JTPS-03A (Primary)	36.22997 142.88166	7990	40	0	40	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.
JTPS-04A (Primary)	36.24424 142.89031	7990	40	0	40	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.
JTPS-05A (Primary)	36.89430 143.40965	7700	40	0	40	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.
JTPS-06A (Primary)	36.91413 143.42354	7710	40	0	40	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.
JTPS-07A (Primary)	37.41496 143.73196	7820	40	0	40	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.
JTPS-08A (Primary)	37.42749 143.73726	7820	40	0	40	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.
JTPS-09A (Primary)	37.68110 143.86610	7550	40	0	40	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.
JTPS-10A (Primary)	37.70031 143.87689	7540	40	0	40	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.

Proposed Sites (Continued; total proposed sites: 29; pri: 29; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JTPC-01A (Primary)	38.00853 144.00566	7570	40	0	40	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.
JTPC-02A (Primary)	38.02804 144.00227	7570	40	0	40	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.
JTPC-03A (Primary)	38.29313 144.05709	7450	40	0	40	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.
JTPC-04A (Primary)	38.57586 144.12499	7560	40	0	40	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.
JTPC-05A (Primary)	38.75801 144.12942	7620	40	0	40	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.
JTPC-06A (Primary)	38.86546 144.14864	7630	40	0	40	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.
JTPC-07A (Primary)	38.91249 144.21916	7400	40	0	40	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.
JTPC-08A (Primary)	39.03126 144.24752	7340	40	0	40	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.
JTPC-09A (Primary)	39.08195 144.21682	7440	40	0	40	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.
JTPN-01A (Primary)	39.24858 144.20297	7460	40	0	40	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.

Proposed Sites (Continued; total proposed sites: 29; pri: 29; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JTPN-02A (Primary)	39.44436 144.21630	7520	40	0	40	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.
JTPN-03A (Primary)	39.51979 144.32902	7250	40	0	40	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.
JTPN-04A (Primary)	39.76647 144.26910	7470	40	0	40	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.
JTPN-05A (Primary)	39.78013 144.27636	7480	40	0	40	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.
JTPN-06A (Primary)	40.05940 144.31855	7570	40	0	40	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.
JTPN-07A (Primary)	40.09392 144.32612	7560	40	0	40	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.
JTPN-08A (Primary)	40.32440 144.40110	7600	40	0	40	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.
JTPN-09A (Primary)	40.39568 144.42047	7620	40	0	40	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.
JTPN-10A (Primary)	40.43742 144.43687	7600	40	0	40	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.