The upcoming IODP Japan Trench Paleoseismology Expedition: New perspectives from tracking past earthquakes in the sedimentary record

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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 multiscale seismic behavior and its consequences. Examining prehistoric events preserved in the geological record is essential to reconstruct the long-term history of earthquakes and to deliver observational 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 the stratigraphic succession. However, at present we lack the 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 (Mw 9 class) earthquakes, International Ocean Discovery Program (IODP) Expedition 386, Japan Trench Paleoseismology, aims at testing and developing submarine paleoseismology in the Japan Trench. We will implement a multicoring approach by Mission Specific Platform shallow subsurface (40 m) giant piston coring to recover the continuous upper Pleistocene to Holocene stratigraphic successions of trench-fill basins along an axis-parallel transect of the 7–8 km deep trench. The cores from 18 proposed primary (and/or 13 alternate) sites will be used for multimethod applications to characterize event deposits for which the detailed stratigraphic expressions and spatiotemporal 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 basins are ideal study areas for testing event deposits for earthquake triggering because they are poorly connected for sediment transport from the shelf and 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 Results from conventional coring covering the last ~1,500 y reveal good agreement between the sedimentary record and historical documents. Subbottom profile images are consistent with basin-fill successions of episodic muddy turbidite deposition and thus define clear targets for paleoseismologic investigations on longer timescales accessible only by IODP coring.

We will apply, further refine, and implement new methods for establishing event stratigraphy in the deep sea and for recognizing giant versus smaller earthquakes versus other driving mechanisms. Our results can potentially produce a fascinating record that unravels an earthquake history that is 10–100 times longer than currently available information. This would contribute to a tremendous advance in the understanding of the recurrence pattern of giant earthquakes and earthquake-induced geohazards globally and provide new constraints on sediment and carbon flux of event-triggered sediment mobilization to a deep-sea trench and its influence on the hadal environment.

This JpGU online presentation will introduce the scientific motivation and background (including latest results from recent research leading up to this upcoming IODP expedition), scientific objective and perspective of this upcoming IODP expedition jointly implemented by ECORD and JAMSTEC-MarE3

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