IODP Expedition 386 “Japan Trench Paleoseismology”: Giant Piston Coring to track past megathrust earthquakes along the hadal Japan Trench

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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. “Submarine paleoseismology” is a promising approach to investigate deposits from the deep sea, where earthquakes leave traces preserved in the sedimentary succession, to reconstruct the long-term history of earthquakes and to deliver observational data that help to reduce uncertainties in seismic hazard assessment for long return periods. Motivated by the mission to fill the gap in long-term records of giant (Mw 9 class) earthquakes such as the 2011 Tohoku-oki earthquake, International Ocean Discovery Program (IODP) Expedition 386, Japan Trench Paleoseismology, was designed to test and further develop submarine paleoseismology in the Japan Trench. This expedition marks the first time, giant piston coring (GPC) was used in IODP, and also the first time, partner IODP implementing organizations cooperated in jointly implementing a mission-specific platform expedition.
In 2021, IODP Expedition 386 successfully collected 29 GPCs at 15 sites (total core recovery 832 m), recovering 20 to 40-m long, continuous, upper Pleistocene to Holocene sedimentary successions of 11 individual trench-fill basins along an axis-parallel transect from 36˚N –40.4˚N, at water depth between 7745–8023 m below sea level. The cores are currently being examined by multimethod applications to characterize and date hadal trench sediments and extreme event deposits, for which the detailed sedimentological, physical and (bio-)geochemical features, stratigraphic expressions and spatiotemporal distribution will be analyzed for proxy evidence of giant earthquakes and (bio-)geochemical cycling in hadal trench sediments. Initial preliminary results presented in this JpGU presentation reveal event-stratigraphic successions comprising several 10s of potentially giant-earthquake related event beds, revealing a fascinating record that will unravel the earthquake history of the different along-strike segments that is 10–100 times longer than currently available information. The data set will enable a statistically robust assessment of the recurrence patterns of giant earthquakes as input for improved probabilistic seismic hazard assessment and provide new constraints on sediment and carbon flux of event-triggered sediment mobilization to a deep trench and its influence on the hadal environment.

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Keywords: IODP, Japan Trench, submarine paleoseismology

