Holocene–Upper Pleistocene event deposit stratigraphy along the Japan Trench: Initial results from IODP Expedition 386 “Japan Trench Paleoseismology”

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Hadal oceanic trenches are the deepest places on our planet. They act as terminal sinks for sediment and particulate and dissolved organic carbon, and form high-resolution archives to unravel the history of subduction zone processes including the giant earthquakes that occur along the trench. 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. Motivated by the mission to fill the gap in long-term paleoseismic records of giant (Mw 9 class) subduction zone earthquakes, such as the Tohoku-Oki earthquake in 2011, International Ocean Discovery Program (IODP) Expedition 386 successfully collected 29 Giant Piston cores at 15 sites (total core recovery 831.19 meters), recovering up to 37.82-meter-long, continuous, upper Pleistocene to Holocene stratigraphic successions of 11 individual trench-fill basins that are expected to have recorded past earthquakes. Preliminary expedition results document event-stratigraphic successions comprising numerous event deposits and initially characterize their different types, facies, properties, composition and frequency of occurrence, which show spatial variations along the Japan Trench. The occurrence of several tephra beds, radiolarian biostratigraphic events and characteristic paleomagnetic secular variations reveals high potential for establishing robust age-models in the Holocene to Upper Pleistocene sequence. In the central Japan Trench, our initial results reveal (1) good correlation of the three marker event beds in the uppermost stratigraphic intervals with the established paleoseismic record of the last 1500 years, (2) good correlation of older thick event deposits with the predicted event-stratigraphy from high-resolution sub-bottom profiles, (3) occurrence of several tens older thick event deposits comprising similar characteristics as event deposits from major historical earthquakes, and (4) no major differences in general sedimentary facies and lithostratigraphy between Holocene and Upper Pleistocene sequences, suggesting that little influence of eustatic sea-level changes for formation of event deposits. Our ~24 kyr paleoseismic record in the central Japan Trench enables new perspectives for the discussion on long-term recurrence patterns of megathrust earthquakes.

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