Using giant piston coring within IODP to track past earthquakes in the sedimentary record along the Japan Trench

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“Submarine paleoseismology” is a promising approach to investigate deposits from the deep sea, where earthquakes leave traces preserved in stratigraphic succession. The concept of studying sedimentary event deposits for reconstructing past earthquake history and related impacts to the marine environment is increasingly being applied in various settings. However, at present we lack comprehensive data sets that allow conclusive distinctions between quality and completeness of the paleoseismic archives, as they may relate to different sediment transport, erosion and deposition processes vs. variability of intrinsic seismogenic behavior across different segments. Nevertheless, many recent studies, which are mostly based on conventional 10-m-long cores, demonstrate the potential of the research concept. With IODP opening its approach to include giant piston coring, a new horizon has opened up for multi-coring expeditions fully dedicated to the rapidly growing field of submarine paleoseismology. IODP is uniquely positioned to address the complex feedback mechanisms between earthquake shaking and its manifestation in the marine archive, decipher related mass fluxes from the shallow to the deep see and to eventually provide longer records to constrain earthquake recurrence far beyond historical catalogues.

Initially building on what sedimentary deposits were generated from the 2011 M9 Tohoku-oki earthquake, the Japan Trench is a promising study area to investigate earthquake-triggered sediment remobilization processes and how they become embedded in the stratigraphic record, and has thus been identified as a primary target for proposing giant piston coring within IODP. In this presentation we summarize recent results and available site survey data collected since the 2011 earthquake, comprising >50, 5-10m long piston and gravity cores from (i) trench-fill and graben-fill basin across the entire trench axis from 36° to 40.3° N (ii), the mid-slope terraces and (ii) from representative slope sites as potential source for sediment remobilization during earthquakes (2) nearly 2000km of high-resolution subbottom acoustic reflection data (Parasound) that reveals striking, up to several meter thick, acoustically transparent bodies interbedded in the otherwise parallel reflection pattern of the trench fill basins. Results from conventional coring covering the last ~1500 years reveal good agreement between the sedimentary record and historical documents in the central part of the margin, and shed new lights on earthquake-triggered, gravity flow-driven supply of significant amount of pre-aged carbon to the hadal environment. New cores retrieved from the southern and northernmost part of the Japan Trench during the recent R/V Sonne expedition SO251 confirm the presence of repeated thick turbidite sequences to be further tested for correlation to historic earthquakes along different margin segments. All these observations underpin the great potential for deciphering earthquake related processes from the stratigraphic record of the small deep-sea trench-fill and graben-fill basins in the Japan Trench, the longer-term record of which is only accessible by giant-piston coring and drilling, as proposed by IODP in Proposal 866.

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