

Shallow-subsurface event stratigraphy along the hadal trench axis of the Japan Trench using subbottom profiler data

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The giant M9 Tohoku-oki earthquake in 2011 has been documented to remobilize a wide area of surface sediment, redistributing from the slope into the >7 km deep Japan Trench forming distinct event deposits in hadal terminal basins. Other than the 2011 earthquake, similarly large earthquakes are historically known along the Japan Trench, and respective deposits have been described in recent studies from cores retrieved from the Japan Trench. Yet, little is understood about (i) the temporal and spatial distribution of event deposits along the entire trench axis, (ii) how the spatial extent may link to historically-reported earthquakes, and (iii) whether older deposits may indicate prehistoric large earthquakes along the Japan Trench. We herein study dm-scale vertical resolution subbottom profiler data acquired during 2012–2016 using PARASOUND and TOPAS recording systems installed on R/Vs Sonne and Shinsei-Maru over the entire Japan Trench area (36.0°–40.5°N), in order to investigate the event-stratigraphic distribution of acoustically-transparent layers that represent sediment remobilization event deposits. The subbottom profiler data generally record well up to ~40 m below the seafloor. Transparent bodies of the upper ~10 m well correlate to event layers reported from sediment cores linked to major historic earthquake such as the AD 2011 Tohoku-oki, AD 1454 Kyotoku, and AD 869 Jogan events. Mapping of these event deposits in the spatially-extensive subbottom profiler data allows to study the spatial distribution of these events and its comparison to their reconstructed rupture areas. Furthermore, the lower part of the hitherto only acoustically-imaged stratigraphic succession of isolated trench-floor basins along the Japan Trench also documents several thick acoustically-transparent bodies. Preliminary interpretation suggests several of the bodies could be event deposits triggered by old large earthquakes. While ground-truth of this interpretation and absolute dating requires long coring efforts in the ultra-deep Japan Trench, our study yields relative stratigraphic information and quantitative constraints of along strike variation of sediment volumes redistributed by episodic events along the Tohoku seismogenic margin.

Keywords: Japan Trench, event deposit, AD 2011 Tohoku-oki earthquake, AD 869 Jogan earthquake, event stratigraphy, High-resolution subbottom profiler