

Along-axis variation of the inputs to the Japan Trench subduction zone revealed from seismic imaging

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Structural features of the incoming plate have been thought to be an important factor which control the seismogenesis and tsunamigenesis in the subduction zone. We have conducted seismic surveys around the Japan trench, where the 2011 Tohoku earthquake ruptured the plate boundary fault through the vicinity of the trench axis. More than 100 seismic profiles were acquired to image sediments, basement and faults in the vicinity of the trench axis which cover the area off Aomori to the north and off Ibaraki to the south. Thickness of the incoming hemipleagic sediments, distribution and throw of the bend-related normal faults on the incoming plate were mapped with interpreted post-stack time migrated seismic sections. Thrust faults and related deformation structure was also imaged in the lowermost landward slope near the trench axis. The incoming sediment varies in thickness along the trench axis. The incoming plate in most of the survey area south of $\sim 40^{\circ}\text{N}$ has about 300–400 ms two-way traveltime (TWT) thickness of sediment with some variation. The incoming sediment is thicker, 500–600 ms TWT, north of 40°N . An area of very thin sediment around $39^{\circ}30'\text{N}$ may be related to petit-spot volcanic activity observed there. Local thickening of the incoming sediment in the trench axis and edge of the graben appears to be related to the presence of trench-fill and graben-fill sediment. We compared incoming sediment thickness and thrust fault distribution to the rupture area of the 2011 Tohoku earthquake. Areas with thicker incoming sediment and are outside the rupture area, whereas the main rupture corresponds to the area with moderate thicknesses of incoming sediment (300–400 ms TWT). This contradicts the argument that great earthquakes occur on subduction zones with thick sediments.

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