Heterogeneous distribution of pelagic input sediments in the Japan Trench and its impact on seismic slip propagation

*Asuka Yamaguchi[1], Yasuyuki Nakamura[2], Ken Ikehara[3], Toshiya Kanamatsu[2], Kazuno Arai[4], Rina Fukuchi[1], Kazuko Usami[3], Juichiro Ashi[1]

1. Atomosphere and Ocean Research Institute, The University of Tokyo, 2. Japan Agency for Marine-Earth Science and Technology, 3. Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, 4. Center for Advance Marine Core Research, Kochi University

Large coseismic slip reached to the Japan Trench caused catastrophic tsunami of the 2011 Tohoku Earthquake (e.g. Fujiwara et al., 2011; Ito et al., 2011; Kodaira et al., 2012). Coseismic slip propagation along the shallow portion of the plate boundary fault would be caused by low friction of smectite-rich pelagic clay consisting the fault, as suggested by researches on core samples taken by IODP Expedition 343 (JFAST) (Ujiie et al., 2013; Kameda et al., 2015; Moore et al., 2015). Recently, large heterogeneities in the thickness of incoming sediments are suggested by high-resolution seismic profiles perfomed by JAMSTEC. To reconcile whether the smectite-rich pelagic clay layer even exists in the area of thin incoming sediments, we analyzed lithologies and sedimentation rates of piston cores sampled from horst-graben structures of the Japan Trench.

All of coring sites are located in off-Sanriku area of the Japan Trench, north of the 2011 rupture area. Seven piston cores (PC01-07) were retrieved from seaward trench slope (PC05 and PC06), horst (PC03 and PC04), graben (PC01), and graben edge (PC02 and PC07) during the R/V Shinsei Maru KS-15-3 cruise. Sediment thickness estimated from seismic profiles are ~30-90 m at horst and seaward trench slope sites, and ~130-340 m at graben/graben edge sites, respectively. Visual core descriptions and successive density and magnetic susceptibility measurement by multi-sensor core logger (MSCL) on split core surfaces as well as X-ray CT imaging of whole-round cores have been performed at Kochi Core Center. Ages of tephra layers were estimated by comparing mineral assemblages and refractive indices of volcanic glasses to those of catalog values, and averaged sedimentation rates of each core were estimated.

Core lithologies are mainly diatomaceous clay/silty clay, with including tephra layers. Sedimentation rates of seaward trench slope, horst, graben, and graben edge are estimated to be ~20-40, ~5-20, ~45, ~1 cm/kyr, respectively. According to these sedimentation rates, sediments on seaward trench slope and horst sites have been deposited within the last 160-660 kyr. Our results suggest that entire pelagic sediments, including smectite-rich pelagic clay, have been removed by some reasons in the last 1 million years, where the thickness of incoming sediment is thin. The lack of smectite-rich pelagic clay may contribute to stop rupture propagation of 2011 Tohoku Earthquake at off-Sanriku Japan Trench. More understanding on sediment dynamics of deposition and erosion at trench outer rise is needed to link subduction input and megathrust earthquakes.

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