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Spatial extent of sedimentation triggered by the 2011 Tohoku earthquake from short-lived radioisotope data, Japan Trench

MCHUGH, Cecilia[1*] ; KANAMATSU, Toshiya[2] ; SEEBER, Leonardo[3] ; CORMIER, Marie-helene[4] ; BOPP, Richard[5] ; IKEHARA, Ken[6] ; USAMI, Kazuko[6]

[1]Queens College, C.U.N.Y., USA, [2]JAMSTEC, Japan, [3]Lamont-Doherty Earth Observatory, USA, [4]University of Rhode Island, USA, [5]Rensselaer Polytechnic Institute, USA, [6]Geological Survey of Japan, AIST

Extensive work has been conducted along the Japan Trench since the 2011 Tohoku megathrust earthquake and tsunami and much has been learnt as a result of these studies that can be applied regionally and globally to other subduction systems. In 2013, the Japan Agency for Marine-Earth Science and Technology conducted expeditions NT13-02 and NT13-19 to the 2011 Tohoku Mw 9.0 megathrust earthquake and tsunami source, with R/V Natushima in 800-5,900 m water depth. The goal was identifying earthquake-triggered deposits and mapping their spatial and temporal distribution, as a strategy to recognize the sedimentary signature of Tohoku-like events and measure recurrence intervals for seismic hazard assessment. Twenty-four piston cores, 3 to 6 m long, were recovered during the NT13-19 expedition along a 300 km-long portion of the mid-slope terrace. This elongated structure is parallel to the strike of the Japan Trench, and located landward of the frontal prism where deformation is most intense. Faults, sometimes forming steep scarps, define small (5km long) confined basins that were targeted for coring.

Very high activities in xs^{210}Pb and concentrations of ^{137}Cs were measured in the upper half-meter of the cores. Detection of ^{134}Cs and enrichment of ^{137}Cs provided a Fukushima signature that was found in the upper 15 cm of several cores. Together with x-ray fluorescence elemental analyses, these radioisotopes provide evidence for multiple pluses of sedimentation triggered by the Tohoku 2011 earthquake and possibly some of its aftershocks, and of older earthquakes that occurred as far back as the last hundred years.

Widespread shaking by the 2011 earthquake induced synchronous fluidization and resuspension of near bottom sediments for ˜250 km along the strike of the Japan Trench. Sediment thickness seems to depend on its proximity to the zone of maximum megathrust slip, but could also depend on local topography and supply of unstable sediment. The sediment deposited as a result of the earthquake shaking is homogeneous and lacks bioturbation. The earthquake also generated turbidity currents as evidenced by sand-rich beds. Proximal to the area of maximum megathrust slip, and presumably disruption on the upper plate, the earthquake caused brecciation, dewatering and minor slumping of sediments. Re-suspended sediments were deposited on the seafloor for at least 30 days after the earthquake and likely for much longer.

Keywords: Sedimentation generated by Tohoku 2011 earthquake, spatial distribution and pulses of sedimentation, short lived radioisotopes track sedimentation, Mid-slope terrace, Japan Trench, detection of Fukushima signature in sediments, sedimentation relative to maximum megathrust slip