Surficial Sediment Entrainment Above Large Megathrust Ruptures: Experimental Study

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Hall B-C (Poster Hall) (Convention Center)

Abstract

The 2011 Mw9.0 Tohoku-Oki earthquake may be representative of “maximum” earthquakes: it ruptured the entire seismogenic depth range of the Japan megathrust, including the shallowest segment that reaches the trench where the displacement grew to 60 m and spawned a catastrophic tsunami. Models and direct seafloor measurements imply a comparably large initial relative motion and sustained long-period oscillations between sediment and water at the seafloor above the shallowest megathrust segment. This motion may develop enough shear to re-suspend sediment, but exclusively for the maximum earthquakes. This new co-seismic sediment-entrainment process should leave a recognizable sedimentary fingerprint of these earthquakes. Our physical experiments are testing effects of this shear between sediment and water and its interaction with high-frequency vertical shaking. We also investigate the impact of sediment properties and slope on the entrainment. We worked on several synthetic mixtures, defined according to the grain size distribution, clay mineralogy and water content with either freshwater or sea water. The grain size distribution is simplified but matches those of sediment cores from different subduction zones. For each mixture, we built matrices of the erosion rates according to the flow velocities, which shows the role of water content and vertical shaking. We have also identified different mechanism during the runs: grain-by-grain or clasts entrainment, stripping, motion of the sediment interface, and formation of a dense sediment layer above the surface. These observations maybe recorded in the associated deposit, suggesting different fingerprinting by the tsunamigenic earthquakes depending on the characteristics of each subduction zone.

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