

M=9.0 Tohoku Earthquake and tsunami; a new interpretation

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M=9.0 Earthquake

A M=9.0 earthquake occurred on March 11, 2011, with its unusually large magnitude drawing our attention. Here, I propose a process different from that of the Benioff-plane origin, one that involves a spray-fault that periodically destroys the fore-arc region. This process involves tectonic erosion, which includes the collapse of the hanging wall of the overriding lithosphere, as well as transport of the collapsed materials into the deep mantle, presumably as far as the mantle transition zone, a process that contributes to the formation of the 2nd Continents through time.

The origin of spray faults is a manifestation of the physically unstable triangular region between the material boundary (trench) and the physical boundary (spray fault). The tightly connected Benioff thrust dragged down the frontal part of overriding plate to reactivate the spray fault, triggering the M=9.0 earthquake.

Tsunami

The spray fault occurs right below the trench-slope break which is a turning point of slope change from the shallow to the deep trench inner wall. Right above the fault, a sedimentary basin is present. Spray faulting resulted in a huge-scale submarine landslide, which led to the collapse of a huge volume of basin sediments, triggering the tsunami off Sendai.

The river drainage system on Northeast Japan is remarkably different from Southwest Japan. Two major rivers, one from the north and the other from the south, transport eroded sediments into the ocean, which contribute to the formation of the sedimentary basin off Sendai. This basin periodically collapses, approximately every 1000 years, causing the ruinous tsunami.