

Upper plate geology controls the rupture area segmentation -A case study of the Nankai Trough

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What controls the earthquake rupture area of megathrust is one of the most fundamental questions in geodynamic research of subduction zone. In the case of the Nankai Trough, Japan, three major controlling factors have proposed so far, surface topography of the subducting plate like seamount, locally strong rigidity of upper plate due to igneous rock composition, and friction property of the plate boundary megathrust including abnormal pore fluid pressure distribution. Such controlling factors are applicable to other subduction zone in general. For example, the topographic high like seamount is proposed to control the location of asperity due to stronger coupling. The topographic-high worked as an asperity contacts with upper plate and rupture could be propagated when the contact breaks. The topographic-high also works as a barrier in the difficult case to be broken. From the geological point of view, plate boundary megathrust in the seismogenic zone must be composed of fault rock in brittle regime because of its temperature range from ~150 °C to ~350 °C, which is cooler than the temperature for the plastic deformation of quartz, feldspar and other rock forming minerals of oceanic crust except for clayey phyllosilicates. In this temperature range, tectonic melange like fault rock with highly pressurized interstitial fluid is expected. Seismic observation showing a reflector with intensive amplitude of negative reflection coefficient suggests a plate boundary fault layer with abnormal fluid pressure. The friction behavior of the fault rock and pore fluid effect is a recent main concern in the subduction zone. The third factor is the mechanical property of the upper plate for the plate boundary megathrust in subduction zone. It is used to treat that the upper plate is a mechanical uniform media saving the elastic energy for theseismic slip along the megathrust. The mechanical property of the upper plate changes for a geological long time scale due to the growth of accretionary prism or tectonic erosion. In addition to such subduction mode of accretion vs erosion, some peculiar tectonic events (e.g. change in convergent direction, some obstacle collision, spreading ridge collision and rapid magmatic accretion etc.) modify the mechanical property of the upper plate and its heterogeneity in space. In the case of the Nankai Trough, a plutonic body is situated beneath the place of epicenter and is suggested to have been functioned as an asperity of 1944 Tonankai and 1946Nankaido Earthquakes. We examined the on-land geology of the Shikoku island and the Kii Peninsula, SW Japan, basement structure and composition beneath the forearcKumano Basin on the basis of recent results of ocean drilling by IODP (Integrated Ocean Drilling Project) and other investigations to infer the geologic composition of the upper plate. As a result we conclude that the key geologic event was middle to late Miocene episodic and rapid growth of forearc crust, mainly due to the magmatic intrusion and extrusion. This event was casued by the eastward migration of the T-T-T triple junction. Such ancient event now controls therupture area of the great earthquake in the subduction zone.

