# Effects of Viscoelastic Fault-to-fault Interaction on Earthquake Generation Cycles

# Chihiro Hashimoto[1], Mitsuhiro Matsu'ura[2]

[1] Dept. of Earth and Planetary Science, Univ. of Tokyo, [2] Dept. of Earth & Planetary Science, Univ. of Tokyo

We constructed a realistic 3-D simulation model for earthquake generation cycles at a transcurrent plate boundary by combining the viscoelastic slip-response function, the slip- and time-dependent fault constitutive law and the steady relative plate motion as a driving force into a single closed system. We examined effects of transient viscoelastic stress transfer after abrupt fault slip through the simulation of earthquake generation cycles for a multi-segmented fault system. The effect of transient viscoelastic stress transfer through the asthenosphere is significant as well as the direct effect of elastic stress transfer, and it gives a possible explanation for the time lag of the sequential occurrence of large events along a plate boundary.

There are many reports on sequential occurrence of large earthquakes along a plate boundary. The occurrence of the 1944 Tonankai and the 1946 Nankaido earthquakes along the Nankai trough, southwest Japan, is one of the good examples. Another example is the migrating earthquake sequence during 1939 - 44 along the North Anatolian fault. These examples of the sequential occurrence of large interplate earthquakes raise the question how one big event triggers another big event with a time lag. The essential cause of the time lag is in the viscoelastic transient stress transfer through the asthenosphere.

We constructed a realistic 3-D simulation model for earthquake generation cycles at a transcurrent plate boundary by combining the viscoelastic slip-response function for a two-layered elastic-viscoelastic structure model, the slip- and time-dependent fault constitutive law that has an inherent mechanism of fault restrengthening, and the steady relative plate motion as a driving force into a single closed system. With this model we examined the effects of transient viscoelastic stress transfer after abrupt fault slip through the simulation of earthquake generation cycles for a multi-segmented fault system. We represented the multi-segmented fault system by introducing a narrow stable creeping zone which divides the single seismogenic region into two parts. The fault system consists of a 30 km-long segment and a 50 km-long segment, separated by a 10 km-long creep zone. After simultaneous dynamic rupture of the small and the large segments, stress accumulation proceeds again with time in both segments at different rates, and the small segment first becomes unstable. The dynamic rupture of the small segment brings about instantaneous stress increase in the large segment, but it does not directly trigger the dynamic rupture of the large segment. The subsequent viscoelastic stress transfer through the asthenosphere accelerates the stress accumulation in the large segment. Then, after about 2 yr, the large segment becomes unstable. The effect of transient viscoelastic stress transfer through the asthenosphere is significant as well as the direct effect of elastic stress transfer, and it gives a possible explanation for the time lag of the sequential occurrence of large events along a plate boundary.