Dynamic triggering of the low-frequency deep seismic tremor in the Southwest Japan

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The low-frequency deep seismic tremors in the Southwest Japan are distributed along a narrow belt paralleling to the strike of the subducting Philippine Sea plate [Obara, 2002]. Pre-existing fluid liberated from the slab with the dehydration process is thought to be responsible for the generation of the tremor. The tremor activities can be characterized by active and inactive stage. Active stages usually start without visible reason, however, sometimes the occurrence of these tremors are triggered by local microearthquakes or teleseismic waves. Although, the triggered tremor activities are only a small part, such dynamic triggering may give us a clue to resolve the mechanism of the tremor and the role of the fluid. In this paper, we shall provide some observational facts that support the dynamic triggering of the tremor activity.

At the present, we have found three cases of the dynamic triggering by teleseismic waves. Tremors in Aichi and Ehime prefecture were triggered by Irian Jaya earthquake (2002/10/10, M7.6, depth: 10km) and Mexico earthquake (2003/1/22, M7.8, depth: 24km), respectively. Both tremors occurred within 10 minutes after the arrival of the maximum amplitude of surface waves. In Ehime prefecture, the tremor occurred eight minutes after the arrival of the S wave radiated from the earthquake of East Russia- Northeast China border region (2002/6/29, M7.3, depth: 566km). The duration of the tremor triggered by Irian Jaya earthquake was only 20 minutes, however, the tremor triggered by Russia China border earthquake continued for a longer time period of a few days. On the other hand, there are some examples of the tremor activity triggered by local microearthquakes with the magnitude of 2 to 3. Within a few to tens of minutes after the occurrence of the microearthquake, the tremor activities started. In a few cases, the triggered tremors were evolved to active stage with long duration of a few weeks.

The remote triggering phenomena has been focussed after the Landers earthquake (1992, M7.3), which induced some microearthquake seismicities in North America [Hill, et al., 1993]. Similar phenomena have also been observed in Japan. For example, microearthquakes in Iwo-jima becomes active just after the arrival of surface wave radiated from big earthquakes [Ukawa, et al., 2002]. In many cases, such remote triggering phenomena are observed in geothermal and volcanic areas. Maybe, the dynamic strain change due to the longer wavelength surface wave increases the fluid pressure and reduces the effective stress. Then the shear fracture is developed and the microearthquake is triggered. As for the deep low-frequency tremor, the seismic wave may induce the bubbling and pressure increasing under the fluid-rich field and the tremor may occur when exceeding the critical situation. Whether the duration time of an induced tremor activity lasts longer or shorter might depend on the volume of existed fluid.