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Non-volcanic and volcanic tremor triggered by teleseismic events detected in the Hokkaido inland area

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Nonvolcanic deep low-frequency tremor reflects the interplate slip process at the deeper part of the locked zone in the subduction zone, like as southwest Japan and Cascadia. The active tremor with long duration time usually occurs accompanied by the short-term slow slip event. However, the minor tremor activity with short duration time occurs frequently accompanied by no detection of crustal deformation. Sometimes, the tremor is triggered by not only the surface wave propagation from large teleseismic events, but also local microearthquakes. In addition to the subduction zone, the nonvolcanic tremor has been detected near Parkfield along the San Andreas Fault. Moreover, similar tremors occurred simultaneously at some places along the fault during the propagation of large-amplitude surface waves from the 2002 Denali earthquake in Alaska. Such tremor phenomena triggered by the teleseismic surface wave was also detected in Taiwan. Triggered tremors might reflect the status of the stress accumulation of the fault system. According to the purpose, we tried to investigate the existence of triggered tremors by teleseismic surface waves in the whole area of Japan islands. As a result, we succeeded to detect the new triggered tremors in Hokkaido area.
The Hi-net velocity waveform data for 25 world-wide major earthquakes from 2001 were analyzed. We compared displacement seismograms with instrumental correction to envelope traces with a pass-band from 2 to 16 Hz and extracted coherent pattern. As a result, we detected triggered tremors in southwest Japan for 10 teleseismic events as reported by Miyazawa and Mori (2006). Outside the subduction tremor area, we detected similar tremors at two places in Hokkaido. One tremor place is near Minami-Furano in the central part of Hokkaido, another is near Nakatonbetsu in northern part of Hokkaido. Both tremors were triggered just after the Mw9. 2, 2004 Sumatra earthquake. The Minami-Furano tremor was also triggered by the Mw8.6, 2005 Sumatra earthquake. The tremor has no clear initial P or S wave. The tremor wavetrain has the amplitude peak at a period of about 20 seconds which is the same as that of the surface wave. The total duration of the tremor is around 200 seconds. The predominant frequency range is 2-5 Hz for the Minami-Furano tremor, which is similar to the subduction tremor in southwest Japan. However, the Nakatonbetsu tremor has higher frequency energy from 5 to 20 Hz. Taking into account the dominant frequency range, we recalculated the envelope traces and located the source of the tremor by the traditional envelope correlation method. The Minami-Furano and Nakatonbetsu tremors are located at depths of around 20 km and 3 km, respectively. The source location of the Minami-Furano tremor is consistent with one of already known clusters of deep low -frequency earthquakes around the Taisetsu volcanic area. On the other hand, there is no volcano, fault, and seismic activity near the source area of the Nakatonbetsu tremor. The variation of the envelope amplitude is similar to that of the Rayleigh wave. We calculated the areal strain from the horizontal displacement based on the Hi-net data. As a result, the Nakatonbetsu tremor well corresponds to the peak contraction of the areal strain. There is a cave near the source location of the tremor. We might expect that the occurrence of the tremor is related to the existence of underground fluid.

Keywords: deep low-frequency tremor, triggering, teleseismic event, surfaced wave