Anormalous low frequency wave trains in the shallow crust near the Lake Towada, northern Japan

yoshiko otani[1], Shingo Aizawa[2], Kazutoshi Watanabe[3], Masahiro Kosuga[4], Kazuo Tanaka[3]

[1] Earth Sci,Hirosaki Univ, [2] Earth Sci., Hirosaki Univ, [3] Faculty of Science and Technology, Hirosaki Univ., [4] Faculty of Sci. & Tech., Hirosaki Univ.

http://hrsryu.geo.hirosaki-u.ac.jp

The Lake Towada, which is located in northern Honshu island, Japan, is an active volcano that has repeated explosive eruptions historically. Hirosaki University has researched the recent activity of shallow earthquakes around the Lake Towada, and found low frequency earthquakes in the deep and shallow crust in September and November 2001 (Watanabe et al., 2002), respectively. Moreover, we have detected the anomalous low-frequency wave trains (LFWTs), which were not observed before. In this study, we will summarize the characteristics of these observed wave trains.

The LFWTs were separately observed for 3 times from October 2001 to January 2002. At the first inspection, each LFWT consists of individual wave packet successively arriving at the rate of 10 per minute. Since the LFWTs were observed not only at the stations UTB and KOSH located at the lakeside, but also at the stations TWWH, SHGH and TTKH slightly apart from the lake, it is supposed that the wave trains were not caused by artificial noises, but were originated from the natural phenomena near the Lake of Towada.

To make sure whether the LFWTs observed at each station have the same origin, we selected a wave packet with high S/N ratio and estimated the temporal variation of correlation coefficient with this master event for each station. Since high values of coefficients were evaluated at the same interval for all stations, the LFWTs are supposed to be composed of low-frequency wave packets successively radiated from the same source. We considered that the identified packets were S wave because of their large amplitudes in horizontal components, and picked the arrival time of the packets with high S/N ratio. Since the estimated hypocenters correspond to the focal region of the shallow low-frequency earthquakes (SLFEQs), our idea that the observed wave packets are SLFEQs is appropriate.

Next, we performed a particle motion analysis for major phases of the LFWTs. The motions are characterized by very linear and E-W trending polarization. This feature is quite similar to that of direct S waves of the SLFEQs. Linearly polarized particle motions observed at most stations suggest a simple source model such as single forces acting to the same direction as the polarization. Such a model, however, does not explain the large vertical motion at TTKH located to the south of focal region. Nevertheless we consider these are not due to site effect, because the S waves of deep low-frequency earthquakes observed at the same station do not show such vertical motions. Consequently the particle motions at TTKH require more complex source model. In addition to the characteristics mentioned above, P waves are hardly visible on the seismograms of LFWTs in contrast to the high-frequency rich P waves for SLFEQs. The spectral amplitude of LFWTs in the frequency range of 2-8Hz estimated from UD component, however, is relatively higher than that of noise spectra, suggesting the existence of P waves with small amplitude.

Judging from the above observational facts, we interpret the LFWTs are composed of the SLFEQs that occurred successively with a very short time interval. Recently, Obara (2001) showed that low frequency tremors occur widely in the lower crust of western Japan. Although the source mechanism of the LFWTs, is probably different from that of tremor because of the difference in the tectonic background, the LFWTs indicates the occurrence of a tremor-like succession of low frequency earthquakes even in the seismogenic shallow crust. To clarify the detailed source mechanisms of LFWTs, we will analyze the temporal variation of polarization and compare the waveform of the LFWTs with the SLFEQs using synthetic seismograms.