Deep and shallow low-frequency earthquakes near the Lake Towada, northern Japan

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

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

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

The Towada volcano, which is located on the volcanic front in northern Japan, has repeated huge eruptions historically. Since August 1999, Hirosaki University has investigated the seismograms observed at the station UTB, which is located at the lakeside of the Lake Towada, and revealed the regular seismicities around this region. Furthermore, since February 2001, the use of seismograms from Hi-net enables us to estimate the hypocenters whose magnitude is smaller than 1.0. Since seismicity is one of the most basic information to grasp the volcanic activity, such high detectability has great meaning to investigate the temporal variation of seismicity. Here we will report the activities of low-frequency earthquakes and summarize the characteristics of the observed waveform, for the period from September 2001 to January 2002.

First, five deep low-frequency earthquakes (DLFEQs) with the focal depths of about 25km were located to the south of the Lake Towada from late September to early October in 2001. Although the P waves were not detected at many stations, observed S waves generally have clear onsets and large amplitudes. The amplitude spectra of ground velocity estimated from the seismograms of the nearest station UTB show band-limited nature with the predominant frequency of 2-4Hz, and rapidly decay above these frequencies. At UTB, observed P waves are generally richer in high frequencies than S waves. These spectral characteristics are commonly observed for the DLFEQs occurred near Osorezan and Esan volcanoes in northern Japan (Sakoi et al., 2001), therefore the DLFEQs are clearly distinguished from the normal shallow earthquakes (NSEQs) that have significant spectral amplitudes around 10 Hz.

About one month after, we have observed the shallow low-frequency earthquakes (SLFEQs) with the depths of about 10km. The epicenters were again located to the south of the Lake Towada, and the total number of SFEQs located rose up to about 70 since then. Hypocenters of NSEQs in the same period form several clusters around the Ogura and Nakayama Peninsula with focal depths from 5 to 7 km. The hypocenters of SLFEQs slightly scatter, nevertheless we conclude the focal region of SLFEQs do not overlap with the clusters of NSEQs, by considering the errors in hypocenter determination. To check the accuracy of focal depths, we compared the S-P times at the station UTB. Since the S-P times of DLFEQs, SLFEQs and NSEQs are about 3s, 1.5s, and shorter than 1.0s, respectively, the difference of focal depths among three types of events is valid. The seismograms of SLFEQs are again characterized by the prominent peak in 2-4Hz and relative richness in high frequencies for P wave. There is a possibility, however, that the latter is not a general feature, because clear arrival of P wave is not visible for many SLFEQs. For SLFEQs duration time of coda following the direct S wave is longer than that of NSEQs having same magnitude. To presume the origin of this long-tailed coda, we compared the band-pass filtered seismograms with a passband from 2 to 4 Hz. Judging from the fact that the low frequency wave packets following direct S wave arrive at the same interval for each station, we confirmed that the coda of these SLFEQs are composed of successive radiations of seismic energy from the source.

From the above facts mentioned, we have confirmed the existence of DLFEQs and SLFEQs to the south of the Lake Towada, which has never been reported before. Number of the SLFEQs decreased from December 2001, and they have been rarely observed since January 2002. At this period, however, the anomalous low frequency wave trains originated from the focal regions of SLFEQs were observed for three times (Ohtani et al., 2002). Through further investigation of these low frequency events, we will clarify its detailed source mechanisms.