Shallow seismicity around the Lake Towada, northern Tohoku, 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.

In this study, we have searched the seismicity aroud the Lake Towada, northern Japan, during the period from 1999 to 2000. As a result, we have found as much as 470 earthquakes, including the 4 swarms. In each swarm, earthquake sequence is supposed to have similar hypocenter location and focal mechanism. Also our result shows that the hypocenters of the swarms do not overlap. The largest event with magnitude 2.6 shows normal fault type focal mechanism solution. In the observed seismograms, we have detected some SP and SS converted waves in P- and S-coda, respectively. Moreover, direct S wave seems to have the S-wave splitting phenomena. In the near future, the use of denser network such as Hi-net would enable us to reveal the more detailed seismicity and underground structures.

The Lake Towada, which is located in Northern Tohoku, Japan, is an active volcano, but the detailed seismological studies have not been made so far. Tohoku Univ. (1995) has reported only one example of swarm activity in early 1995. Since recently Aomori Prefecture developed the station UTB, which is located at the lakeside, the monitoring for the seismicity around the Lake Towada is now available at the Hirosaki University. In this study, we will briefly summarize the shallow seismicity around the Lake Towada in the period from January 1999 to December 2000. In addition, we will mention the structures in the shallow crust, from the analysis of particle motions of observed seismograms.

By using the seismograms of UTB, we have searched the ultramicroearthquakes that were not triggered by the routine seismic network of Hirosaki University, especially for the period from August 1999 to December 2000. At the station UTB, 3-component short period seismometer is installed at the depth of 100m to avoid the surface cultural noise, hence the seismograms having high S/N ratio are utilized for high detectability of earthquakes. Finally we determined hypocenters for events with at least three readings of P-wave onset times.

As a result, we found as much as 470 earthquakes in total, including the 4 swarm activities. Observed S-P times at UTB range from 1 to 3s, therefore the epicenters of some events are outside the Lake Towada. Since lots of the events occurred during the swarms, the regular level of seismicity is estimated to be more than 100 events per year. Such high activities were not revealed yet. The magnitudes for 32 located events range from 0.5 to 2.6. Most of them were located in the southern part of the Lake Towada, and the depths are shallower than 5km.

The observed seismograms in each swarm have similar waveforms from the onset of P wave to coda, without few exceptions having reversed polarity at UTB. Consequently, such earthquake sequence is supposed to have similar hypocenter location and focal mechanism in each swarm. We notice that larger magnitude events tend to occur in the swarm, not independently. For such events, the hypocenters estimated here do not overlap, by considering the small errors in hypocenter determination with more P- and S-wave readings. The largest event with magnitude 2.6, which occurred in the center of the Lake Towada during the swarm on October 30, 1999, shows normal fault type focal mechanism solution with the T-axis in NNE-SSW direction. Such event is quite rare and therefore noticeable, because the reverse fault type solutions are usually observed in northern Japan.

For the 3 events with magnitudes larger than 2, we have detected some distinct phases in P-coda at UTB and OAT, which are about 25km apart from UTB. Such phases show the quite similar particle motions with the direct P-wave, so they are inferred to be SP converted wave originated in the ray path between the hypocenter and the station. Such phases were also observed in S-coda, and we identified them as SS scattered wave because of the same characteristics with the direct S wave. Moreover, direct S wave seems to have the S-wave splitting phenomena with the faster arrival of NNE-SSW oscillation. The inferred direction of fast S wave is, however, not consistent with the local stress field estimated from earthquake focal mechanism. Detailed analysis using more data is needed to understand the cause of this contradiction.

Although we have revealed the outline of the seismicity around the Lake Towada in this study, restriction of sparse seismic stations cannot enable us to obtain the more detailed information about both the seismicity and the structures. In the near future, the use of denser network such as Hi-net would become quite important to reveal the crustal activities around the Lake Towada.