Geology and seismic motion in the Tamugiyama area, Niigata, extremely damaged by the 2004 Niigataken-Chuetsu Earthquake.

Yoshinori MIYACHI[1]; Atsushi Urabe[2]; Tomio Inazaki[3]; Masahiko Makino[4]; Taku Komatsubara[5]; Tsutomu Nakazawa[3]; Masayuki Yoshimi[6]; Sunao Kunimatsu[6]; Rei Nakashima[7]; Katsumi Kimura[8]; Masanori Ozaki[3]

[1] IGG, AIST; [2] Resear. Inst. Hazards for Snowy Areas, Niigata Univ.; [3] GSJ, AIST; [4] GSJ,AIST; [5] Geol. Surv. Japan; [6] Active Fault Research Center, GSJ/AIST; [7] Institute of Geoscience, AIST; [8] GSJ/AIST

The Niigataken-Chuetsu Earthquake, magnitude 6.8, occurred in the middle part of Niigata Prefecture, central Japan, at 17:56(JST) on October 23, 2004. Large number of wooden houses have been extremely damaged on the Kawaguchi, Tamugiyama, Wanazu, Budokubo and Shindojima areas. We focus our attention on the Tamugiyama area, where uneven distributions of severe damaged dwellings biased by microtopography have been reported. In order to investigate the relationship among the damage, geology and seismic motion in the Tamugiyama area, we have conducted a series of in-depth investigations; classification of surface microtopography, lithofacies analysis by field survey, and standard penetration tests (SPT), the velocity-logging tests, and microtremor measurement. In this presentation we intend to report the results of our investigations.

The Tamugiyama area is divided into two parts, the flat plain and the sloped area. The flat plain is considered to be formed by the flow of the main stream and the slope area is made up of fan deposits. In the following sentences, we call the former the main stream terrace and the latter the fan terrace. The main stream terrace and the fan terrace surface are smoothly connected. Our precedent investigation has clarified that the heavily damaged dwellings on Tamugiyama area have been unevenly distributed; most of the houses built on the main stream terrace have suffered slighter damage as a whole, in contrast, many of those located on the fan terrace have suffered severe damage such as total collapse. It is surmised that the local difference of the damage between the areas is related to the difference of the physical properties of the terrace sediments.

We carried out drilling explorations (SPT) at two sites; one (GS-TMG-1N; 40m long) is on the fan terrace (N37 14.107 E138 51.499), and another (GS-TMG-2N; 30m long) is on the main stream terrace (N37 14.264 E138 51.437). We also carried out the velocity logging in each borehole.

Results of the borehole drilling exploration are as follows.

GS-TMG-1N: Terrace deposits 17.5 m thick. AT tephra at GL -6 m.

GL 0.00 to -9.25 m: peaty silt and silty sand, GL -9.25 to -15.45 m: sand with silt and granule, GL -15.45 to -17.50 m: pebble, below GL -17.50 m: pebbly sandstone.

GS-TMG-2N: Terrace deposits 20.0 m thick. AT tephra at GL -1.6 m.

GL 0.00 to -17.75 m: sand and silt, GL -17.75 to -20.00 m: pebble, below GL -20.00 m: sandstone

Thus, the terrace deposits consist mainly of peaty silt and fine-grained sand in the upper part and pebble or pebbly sand in the lower part. Noteworthily, a relatively thick peaty silt bed occurs in the upper part of the succession at the GS-TMG-1N site near the extremely damaged area. The bed is characterized by the N-value of less than 10. The terrace deposits unconformably overlie the Pliocene Wanazu Formation composed mainly of sandstone.

Results of the velocity-logging test are as follows.

The shear wave velocity, Vs, of the Wanazu Formation is 500 - 700m/s, and Vs of terrace deposit is 400 - 100m/s in both drilled holes (GS-TMG-1N, GS-TMG-2N). In the organic soil layer of the fan terrace site (GL -6--9m), the velocity of the seismic wave is characteristically slow. These velocities match those estimated from N-values obtained by the drilling tests.

Microtremors were measured along the 500 meters long observation line near the borehole sites mentioned above. Twenty stations with 5 m intervals were used for each microtremor measurement, and the seismometer, of which the natural period was 1 second, was set at each station. Each measurement consists of four sets of 32 seconds samplings. The result obtained by the spectral analysis of observed microtremors shows that the predominant frequency is about 5 Hz at the station on the fan terrace where wooden houses were heavily damaged, on the other hand, that the predominant frequency is about 10-15 Hz on the main stream terrace.