

## Low-frequency earthquakes and shallow seismic activity in the Nikko-Ashio area

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The Nikko-Ashio area, the northwestern part of Tochigi prefecture, is one of the most seismically active regions in Japan. Tectonic background in the region is dominated by the Pacific plate subducting westward from the Japan trench. The Nikko-Ashio area is located on the southeast end of the volcanic front expanding from the Tohoku to the Kanto caused by subducting Pacific plate. Active volcanoes such as Mt. Sirane and Mt. Nantai and active faults such as Uchinokomori fault are in the region. A large amount of shallow earthquakes about 8,000 a year have been observed around those active faults by routine observation of the Earthquake Observation Center, Earthquake Research Institute (ERI). The specific characteristics of the activity are as follows: 1. Events are mainly located in three regions. 2. Earthquakes occur separating into clusters. 3. The depth of earthquakes is shallower than 15 km and tends to shallower toward Mt. Sirane. 4. Reflected phases SxS and SxP are seen in the waveform. 5. Deep low frequency earthquakes at depths of 20 to 40 km occur almost vertically beneath the region.

In this study we focus on the relation between low-frequency earthquakes and shallow earthquakes above those with the velocity structure. In the routine work, we usually detect low-frequency earthquakes in the area about one a month, but sometimes more than dozens of them occur at a time. In March 11, 2002, we observed about 56 low-frequency earthquakes during 2 hours and in January and March, 2005, we observed 17 ones. After that, shallow earthquakes in the Ashio area obviously increased. In order to search a clue of these sequences and relationships, we obtained velocity structure model determined by tomographic inversion method applied to the travel-time data during the period from April, 2002 to December, 2006. As results it is found that low-frequency earthquakes occur in the edge of high  $V_p/V_s$ , low  $V_p$ , low  $V_s$  areas which mean melt and high  $V_p/V_s$ , low  $V_p$  and low  $V_s$  areas spread widely at depths of 20 to 30 km. Combining all the fact, we surmise that low-frequency earthquakes may occur as the results of ascending magma flow and intermittent rapid magma flow may cause many low-frequency earthquakes at a time. Upwelling magma flow accumulates at a depth of  $\sim 20$  km and the dehydration from the magma weaken the strength of the crust and causes shallow earthquakes.