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Detailed seismic activity beneath the Nikko-Ashio area revealed by a tomographic analysis

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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 area is located on the southeast end of the volcanic front expanding from the Tohoku to the Kanto. Active volcanoes such as Mt. Shirane and Mt. Nantai and also active faults such as the Uchinokomori fault are in the region. A large amount of shallow earthquakes about 6,000 ~ 8,000 a year have been observed around active faults by the routine observations of the Earthquake Research Institute (ERI). The specific characteristics of the activity are as follows: 1. Earthquakes are mainly located in two regions. 2. Earthquakes separate into clusters. 3. Most earthquakes occur within a depth of 15 km. 4. The distribution tends to shallower toward Mt. Sirane. 5. Obvious SxS and SxP phases reflected from a crustal discontinuity are in the seismograms. 6. Deep low frequency earthquakes at depths of 20 to 40 km occur beneath the region.

Recently, many researchers have investigated what factors cause inland crustal earthquakes. Understanding of the Nikko-Ashio earthquakes will provide information concerning the construction of solutions.

To now we conducted time series analyses and travel time analyses for Nikko-Ashio data. We have obtained some information concerning velocity structures and seismic distribution..Low-frequency earthquakes have occurred about one a month, but sometimes more than dozens of them occur at a time. After that, shallow earthquakes obviously increase. From a tomographic study we have found that low-frequency earthquakes occur at the edge of high Vp/Vs areas and high Vp/Vs, low Vp and low Vs areas spread widely at depths of 20 to 30 km. We interpret that low-frequency earthquakes occur as the results of ascending magma flow and intermittent rapid magma flow causes many low-frequency earthquakes at a time. Upwelling magma flow accumulates at a depth of ~20 km and the dehydration from the magma weaken the strength of the crust and causes shallow earthquakes.

In this report, we investigate precise earthquake distribution to obtain an improved understanding of these systems connected with magma or fluid. In the seismograms, there are many similar earthquakes. We adopt tomoDD inversion method to the travel time data with those wave correlation data during the period from April, 2002 to December, 2009.

Keywords: seismic distribution, low frequency earthquake, magma, fluid, velocity structure