

## Tectonic provinces of the Northern Fossa Magna region depicted by means of the crustal movement and seismic activity

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In the Northern Fossa Magna (NFM), large crustal earthquakes had been occurred in 1847 (the Zenkoji Earthquake) and recently. Understanding the tectonic provinces of the upper crust is important in order to clarify the generation mechanism of the crustal earthquakes. The purpose of this study is revealing the tectonic provinces of the NFM region depicted by means of the regional characteristics of the crustal activity. The author investigated the crustal movement and the depth of the seismogenic layer by analyzing GNSS observation data and hypocenter data, respectively.

Velocity field and strain rate field were estimated by analyzing GNSS observation data of GEONET and University of Toyama, from October 2007 to March 2011. The depth of the seismogenic layer was evaluated using the JMA unified hypocenter catalog from January 2003 to March 2011. Noises and low-frequency events were removed from the catalog with hypocenters that focal depth is shallower than 40 km and magnitude is larger than 0.1. Relocation and declustering process of the hypocenters were not conducted in this study. The depth of the seismogenic layer was evaluated by means of the methods of Ito and Nakamura (1998), the depth which 10%, 50%, and 90% of hypocenter occur are defined as the upper, middle, and lower depth of the seismogenic layer.

As the results, considerable lateral variation in the crustal activity was revealed in and around the Niigata-NFM region. The strain concentrate zone consisted of the WNW-ESE trend contraction strain more than 0.15 ppm/yr distributes from the north region of Niigata Prefecture to the central region of Nagano Prefecture, and this zone corresponds to the northeastern part of the Niigata-Kobe Tectonic Zone (Sagiya *et al.*, 2000). The displacement direction in the horizontal velocity field changes from eastward in the northwestern part of the Niigata-NFM region to northward in the southern part. The depth of the seismogenic layer shows lateral variation of about 10 km beneath the NFM region, and the inland region with a relatively shallow depth of the seismogenic layer corresponds the location of active volcanoes. Focal mechanisms of the shallow crustal earthquakes in the NFM region show reverse fault type and strike-slip fault type. These different mechanisms indicate that seismotectonic stress varies around this region.

These results suggest the existence of the geodetic and seismological tectonic boundary that trends to NE-SW direction and inclines toward the west. This tectonic boundary is located obviously on the west side of the geological tectonic boundary, the Shibata-Koide Tectonic Line (Yamashita, 1970) and Tsunan-Matsumoto Tectonic Line (Kosaka, 1984), along the eastern margin of the Shin'etsu sedimentary basin. A conclusive model for the tectonic provinces of the Niigata-NFM region shows that the tectonic boundary separates the whole crust into two provinces which having different characteristics in the horizontal velocity field, seismogenic layer depth, and surface geology. The lateral variation in the seismogenic layer along the geodetic and seismological tectonic boundary might be the cause of generating the shallow crustal earthquakes in the NFM region. In order to discuss about the detailed tectonic provinces of the NFM region, it is necessary the crustal activity are evaluated by various observations with high spatial resolution.

Keywords: tectonic province, tectonic boundary, Northern Fossa Magna, strain concentrate zone, seismogenic layer