

Thickness of the seismogenic layer, location of large earthquakes, and b-value of the Gutenberg-Richter relationship

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The thickness of the seismogenic layer is one important parameter for earthquake prediction. The number of studies have estimated the regional changes of the seismogenic layer and reported that these spatial changes are closely connected with the thermal structure of the upper crust (ex. Kobayashi, 1977; Ito, 1990). Moreover, the region, where the deeper limit of crustal earthquakes or the thickness of the seismogenic layer steeply changes, well corresponds to the location of historical crustal large earthquakes or Quaternary active faults (Ito, 1999; Ochi and Zhao, 2001).

In this study, we used the Japan Meteorological Agency (JMA) unified catalogue from October 1997 to February 2005. We estimated the shallower and the deeper limits of crustal earthquakes from well-located events of the JMA unified catalogue, basically following the Ito(1990)'s method. We will show that the thickness of the seismogenic layer closely correlates with the b-value of the Gutenberg-Richter (G-R) relationship by using the Akaike Information Criterion (AIC)(Akaike, 1974). That is to say, the b-value of the G-R relationship is found to be low in regions of thick seismogenic layer. The large crustal earthquakes are found to have occurred in such regions. On the other hand, no correlation is found between the spatial gradient of the thickness of the seismogenic layer and the location of the large earthquakes.

The result might be affected by systematic errors in hypocenter location in the JMA unified catalogue. Therefore, we also evaluate the significance of the b-value difference by using events whose epicenter is located within 5 kilometers from the nearest observation station, because these events are located with relatively high accuracy. The result also indicates that the b-value of events occurring where the seismogenic layer is thick, is significantly smaller than that in areas where the seismogenic layer is thin. Accordingly, the result is not affected by systematic errors in hypocenter location.