

The dependency of the b-value on the focal mechanism and on the hypocentral depth

Takeo Ishibe[1]; Hiroshi Tsuruoka[2]; Kunihiro Shimazaki[3]

[1] ERI, Univ. of Tokyo; [2] ERI, Univ. of Tokyo; [3] Earthq. Res. Inst., Univ. Tokyo

The Gutenberg-Richter relationship (Gutenberg and Richter, 1944) $\log n = a - bM$, where n is the number of events with magnitude equal to M , and a and b are constant values, has been used to describe the regional seismicity. The b -value, which characterizes the frequency ratio between small and large earthquakes, has been correlated with various aspects of earthquake occurrence. In this study, we show that the b -value varies systematically for different styles of faulting: normal faulting events have the highest b -values, thrust events the lowest and strike-slip events intermediate values. The dependency of the b -value on focal mechanism is commonly recognized for various catalog data sets and consistent with the result of Schorlemmer et al. (2005). These results suggest that the b -value may act as a stress indicator depending inversely on stress.

We indicated that the b -value does not depend on hypocentral depths for shallow crustal earthquakes in the unified JMA catalog when we exclude aftershocks of large earthquakes or we only use the near-events located within 5 kilometers from the nearest observation station. (Ishibe and Shimazaki, 2007a; 2007b). On the other hand, Mori and Abercrombie (1997) examined the depth changes in the b -value for the Northern and the Southern California region and showed that the b -value decreases systematically as the hypocentral depth increases regardless of including or excluding aftershocks of large earthquakes. They interpreted that this is because the heterogeneity of crust decreases and the stress level increases as an increase of depth. Wiemer and Wyss (1997) showed a characteristic dependency of the b -value on hypocentral depths for the Morgan Hill and the Parkfield segments of the San Andreas fault. Gerstenberger et al. (2002) reported that 30% of California region showed significant decrease of the b -value with an increase of hypocentral depth by Utsu (1992)'s test. In this study, we indicate that the depth changes in the b -value for shallow crustal events in Japan strongly depend on earthquake catalog, and suggest that apparent depth changes in the b -value may be caused by some unknown biases in magnitude determination and/or in location.

References

- Akaike, H., 1974, A new look at the statistical model identification, *IEEE Trans. Autom. Control*, vol. AC-19, pp 716-723
- Gerstenberger, M., S. Wiemer and D. Giardini, 2001, A systematic test of hypothesis that the b -value varies in depth in California, *Geophys. Res. Lett.*, 28, NO1, 57-60.
- Gutenberg, B. and Richter, C.F., 1944, Frequency of earthquakes in California, *Bull. Seism. Soc. Am.*, 34, 185-188.
- Ishibe T. and Shimazaki K., 2007a, Apparent depth changes in the b -value of the Gutenberg-Richter relationship, Programme and Abstracts the seismological society of Japan 2007 fall meeting, P03-29.
- Ishibe T., and Shimazaki K., 2007b, Correlation among the hypocentral depth, the thickness of the seismogenic layer and the b -value of the Gutenberg-Richter relationship, Programme and Abstracts the seismological society of Japan 2007 fall meeting, D32-06.
- Mori, J. and R. E. Abercrombie, 1997, Depth dependence of earthquake frequency-magnitude distributions in California: Implications for rupture initiation, *J. Geophys. Res.* 102, B7, 15,081-15,090.
- Schorlemmer D., S. Wiemer and M. Wyss, 2005, Variations in earthquake-size distribution across different stress regimes, *Nature*, 539-542.
- Utsu, T., 1992. On seismicity, In Report of the joint Research Institute for Statistical Mathematics, Institute for Statistical Mathematics, Tokyo, 139-157.
- Wiemer S., and M. Wyss, 1997, Mapping the frequency distribution in asperities: An improved technique to calculate recurrence times ?, *J. Geophys. Res.*, 102, 15,115-15,128.