2013年と2014年に栃木県北西部で発生した2つの地震(Mj6.3,Mj5.1)に先行するb値の時間変化の検出可能性

Detectability of temporal variation of b-value prior to two earthquakes (Mj6.3 in 2013, Mj5.1 in 2014) in Northern Tochigi Prefecture

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It has been reported that the b-value decreases prior to large earthquakes in nature (e.g., Imoto, 1991) and failure of a rok sample in laboratories (e.g., Scholz, 1968) . To discuss a temporal variation of the b-value, a sufficient number of earthquakes is required. In general, calculation of b-value prior to large earthquakes requires long-term data because seismic activity is not always high at that term. In other words, the temporal resolution of b-value variation before a large earthquake is usually low. Therefore, sufficiently high seismic activity before the large earthquake is required to evaluate the b-value variation precisely.
For example, two major earthquakes occurred in northern Tochigi Prefecture: Mj6.3 in 2013 and Mj5.1 in 2014. The two events followed the increase of seismic events. One possible cause of this increase is the Mw9.0 Tohoku earthquake in 2011 (e.g., Aketagawa, 2011).
In this study, we try to detect the temporal variation of the b-value in northern Tochigi Prefecture where a large number of earthquakes could be observed in a short period prior to the two major events. First, to increase the temporal resolution, we calculate the b-value for a circular region with 20km radius from the epicenter of the Mj6.3 event; the result is shown in Figure A. While the b-value was greater than 1.0 and stable before March 2011, it dramatically decreased to ~0.6 after the occurrence of the Tohoku earthquake in 2011 and recovered to around 1.0 almost within one year. After that, it decreased to ~0.7 again following the Mj6.3 event in 2013 and recovered to ~1.0 within a small period. Although it decreased to ~0.75 again following the Mj5.1 event in 2014, it did not recover but continued, at least, one year. Regarding these different variations in each sequence, we considered the seismic activity in northern Tochigi precisely. We consider regions 1, 2, and 3. The region 1 is located south of the source region of the Mj6.3 event and includes an active fault. The regions 2 and 3 include the source areas of the Mj6.3 and Mj5.1 events, respectively. The temporal variation of b-value for each region is shown in Figure B, C, and D. In region 1, constant seismic activity has continued for the whole term and the b-value was stable and greater than 1.0. The b-values are also stable but ~1.0 in region 2 and ~0.75 in region 3. On the basis of these results, we found that the temporal variation of the b-value of the entire region is affected by the temporarily activated one of the three regions. However, in regions 2 and 3, the numbers of events to calculate the b-value precisely are insufficient despite their activation. So we found that we cannot detect temporal variation of the b-value prior to the major events. This finding tells us that we need to consider the target region carefully when we research the temporal variation of the b-value.
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