Seismicity and crustal deformation following the 2016 Kumamoto earthquakes

*Kazuyoshi Nanjo[1], Jun Izutsu[2], Yoshiaki Orihara[3], Masashi Kamogawa[4], Toshiyasu Nagao[3]

1. University of Shizuoka, 2. Chubu University, 3. Tokai University, 4. Tokyo Gakugei University

The 2016 Kumamoto earthquakes include a magnitude *M*7.3 mainshock that struck April 16, 2016, as well as *M*6-class foreshocks (*M*6.5 and *M*6.4) and many *M*5-class aftershocks. This seismicity that fulfils sections along the Futagawa and Hinagu faults, is still being active. Seismicity and crustal deformation in the Kumamoto region were investigated to get implications of future seismic-activity trends.

We referred our previous work (Nanjo et al., 2016) that examined the spatial and temporal trend in *b* value of the Gutenberg-Richter’ s law, based on seismicity prior to the Kumamoto earthquakes. For the spatial distribution of *b* values, which shows data for a post-period (January 2017-January 2019), excluding the active aftershock period, we found a zone with low *b* values (130.6-130.8˚E, 32.5-32.6˚N), which lays further to the southwest of the *M*6.5 and *M*6.4 foreshocks along the Hinagu fault. A comparison with the spatial distribution of *b* values calculated for the seismicity from January 2000 to immediately before the Kumamoto earthquakes (Nanjo et al., 2016) reveals a zone where the *b* value decreased. This zone coincides with the low-*b*-value locations seen for seismicity after 2017. We compared the spatial distribution of earthquakes with *M*>5 in the Kumamoto sequence and the *b*-value distribution based on seismicity after 2017. Earthquakes with *M*> 5 have not occurred in the low-*b*-value zone.

While referring previous studies of crustal deformation associated with the Kumamoto earthquakes by GEONET (e.g., Hiyama et al., 2016), we investigated baseline changes of control stations near the Futagawa and Hinagu faults (the period from January 2013 until the end of 2018, with the “Misumi” (Shimane pref.) taken as a fixed station). A step-like change associated with the mainshock occurrence, followed by gradual changes associated with postseismic formation, is seen for all the baselines investigated. The same is true for the control station “Izumi” (130.79˚E, 32.58˚N), located in the low-*b* -value zone identified for seismicity after 2017, although the postseismic deformation is coming to an end. Therefore, active seismicity is expected to continue in the future.

Our method pinpointed the zone of low *b* values along the Hinagu fault, and this is the only one where the *b* value has decreased, compared to before the Kumamoto earthquakes. Nanjo et al. (2016) compared the *b*-value map with the sequence of foreshocks, mainshock, and aftershocks with *M*5 or greater, and showed that areas of low *b* values contained a high percentage (84%) of the sequence. If the *b* value is regarded, for the Kumamoto region, as an indicator for estimating the occurrence location of a relatively large earthquake in the future, the current low-*b*-value zone shows the high likelihood of “seismic gap”, a segment considered to suffer a future *M*>5 earthquake.

Keywords: 2016 Kumamoto earthquakes, b value, crustal deformation

