Stress state inferred from b-value and focal mechanism distributions in the aftershock area of the 2005 West Off Fukuoka Prefecture earthquake

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The spatiotemporal stress states in the aftershock region of the 2005 west off Fukuoka prefecture earthquake are examined via an analysis of the b-values and focal mechanism solutions. The aftershocks are aligned roughly NW–SE, with the southeastern part of the aftershock region believed to correspond to Kego Fault, which extends beneath the Fukuoka metropolitan area. A previous research highlighted the possibility of a large stress concentration around the southeastern end of the aftershock area (Iio et al., 2006). It is thus important to assess the present stress states in the study area since the SE extension of the earthquake fault runs through the part of Fukuoka City. The unified earthquake catalog (JMA catalog) maintained by the Japan Meteorological Agency (JMA) and focal mechanisms estimated from F-net data operated by the National Research Institute for Earth Science and Disaster Resilience (NIED) were used for the b-value calculations and the stress tensor inversion, respectively. The analysis period in this study is from April 20, 2005 to January 31, 2020. The b-value, which represents the relative proportion of large to small earthquakes (Gutenberg and Richter, 1944), is inversely related to differential stress (Scholz, 1968, 2015). This study reveals depth-dependent b-values in the focal region, where the b-values are generally higher (b = 0.7–1.4) above the mainshock depth (9.5 km) and lower (b = 0.5–1.0) at greater depths. The shallower region possesses a significant temporal increase in b-values, whereas a lateral b-value heterogeneity is observed in the deeper region. The b-values (b ˜ 1.0) near the mainshock are relatively high, whereas the northwestern and southeastern edges of the deep region have lower b-values (b = 0.5–0.7). On the other hand, many of the focal mechanisms for the M 3.5 events are located in the low b-value area of the deep region. The stress-tensor inversion results reveal a change in stress state from strike-slip to strike-slip/normal faulting. These findings imply that the stress state remains high and/or slightly decreased in thenorthwestern and southeastern parts of the deep region. These results and the findings of previous research on this earthquake sequence suggest that the likelihood of future large earthquakes along the southeastern part of the aftershock region should be considered relatively high.

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