Source scaling and stress drop for the 2018 Hokkaido Eastern Iburi earthquake sequence estimated by the S-wave coda spectral ratio method

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Source scaling and variation in stress drops play an important role not only in understanding source physics but also in advancing strong ground motion prediction because stress drop is an essential source parameter to control the high frequency ground motion amplitude. We estimated corner frequencies and stress drops for the 2018 Hokkaido Eastern Iburi earthquake sequence based on the S-wave coda spectral ratio method (Somei et al., 2014) to elucidate the source scaling and factor for variation in stress drops.

We analyzed 54 events (M_w 3.6-6.6) including the mainshock in the 2018 Hokkaido Eastern Iburi earthquake sequence. We collected ground motion records observed at KiK-net and F-net stations located in Hokkaido and Aomori prefectures. For KiK-net stations, we used acceleration time histories recorded by downhole strong motion sensors. For F-net stations, we used velocity time histories recorded by both strong motion and broadband seismographs. We followed the procedures of Somei et al. (2014) to process the data. The source spectral ratio for one station was obtained by the amplitude spectral ratio between large and small event records. For calculating the amplitude spectra, we used the S-wave coda portions in the same lapse time window between the event pair as the analyzed time window. In order to guarantee the commonality of decay curves in the time windows between the event pair, we examined the decay ratios of RMS envelopes in S-wave coda for six narrowband frequency ranges. The observed source spectral ratios were well explained by the ω^{-2} source spectral model, and we could estimate the corner frequencies for large and small events by grid search method. For comparisons, we also obtained the source spectral ratios from the observed spectral ratios for direct S-waves. We could clearly see the source spectral ratios derived from S-wave coda are much more stable by station to station than those derived from direct S-wave portions.

Assuming a circular clack fault model, the stress drop could be estimated from the seismic moment and the source radius (Eshelby, 1957). The source radius could be related to the corner frequency (Brune, 1970, 1971). In this study, the seismic moment of each event was fixed at the value provided by its F-net moment tensor solution. Stress drops for all 54 events spanned from 0.08 to 6.18 MPa. The stress drops of the mainshock (M_w 6.6) and the averaged value for all the aftershocks are 6.18 and 0.40 MPa, respectively. The stress drops of aftershocks do not exceed that of mainshock, which is the same result as that of Somei et al. (2014). Stress drops for the 2018 Hokkaido Eastern Iburi earthquake sequence are in the variation of those for past inland crustal earthquakes in Japan (Somei et al., 2014) although the stress drop of the mainshock is slightly larger than those of the other large inland crustal events. To investigate the factors of variations in stress drops independent of seismic moment, we examined possible correlations between stress drop and some tectonic effects such as regionality, focal mechanism, and source depth. Although there are no obvious correlations of stress drops with regionality and focal mechanism, we could see the dependence of source depth on stress drops for the aftershocks of the 2018 Hokkaido Eastern Iburi earthquake sequence.

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