Comparison of scattering variation associated with 2016 earthquakes in Korea and Japan

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A remarkable increase of scattering attenuation (Q_S^{-1}) at low frequency was found associated with hazardous earthquakes in Japan and Korea in 2016. Applying Multiple Lapse Time Window Analysis (*MLTWA*) to N-S component seismograms recorded in the before earthquake period (*BEP*) and after an earthquake period (*AEP*), the Q_S^{-1} values were compared for M7.0, 6.6, and 5.8, occurred in Kumamoto (*K)*, Tottori (*T*), and Gyeongju (*G*). The *BEP* and *AEP* were set to obtain enough data; while G was 5 and 14 years, *K* and *T* event was 5 and 5 years, and 4 and 3 years, respectively. The obtained events of the periods were 186 and 117 for Korea, whereas 501 and 619, 176 and 194 for two Japan events, respectively. To find the crustal variation associated with earthquakes, focal depths of events were shallower than 30 km and the hypocentral distance of seismograms was shorter than 80 km. The observed stations were applied by coda normalization to correct different earthquake sources and site amplification factors. The magnitude range of events was selected between 2.0 and 4.0. For band-pass filtered with five central frequencies of 1.5, 3, 6, 12, and 24 Hz, the best fit values for Q_S^{-1} and Q_I^{-1} (intrinsic attenuation) were obtained by comparison between observed energy curves and theoretical energy curves derived from direct simulation Monte Carlo method (Yoshimoto, 2000) with a focal depth of 10 km. The error bars of the values, derived from Fisher’ s *F* distribution with the confidence value of 60 %, shows reliably shorter lengths with more than 20 observations. Between *BEP* and *AEP* of the Q_S^{-1} values, the higher difference was observed at lower frequencies –remarkable at 1.5 Hz and negligible for 24 Hz. Whereas G event being the greatest difference in the epicentral region, the T event showed reliable difference with over the error bar range. However, T events showed little relevance of differences in the epicentral region.

The crustal inhomogeneity caused by open cracks had been observed in the seismically active area by coda analysis using tomography developed by Nishigami (1991). *MLTWA* also showed the seismic inhomogeneity by comparison of difference of Q_S^{-1} between *BEP* and *AEP*. The difference corresponds well to event magnitude represented by peak ground acceleration (*PGA*). The high difference in *K* and *G* events generally correlated with the high *PGA* area. However, the *T* event shows less relevance despite the large magnitude. This may be due to earthquakes with a comparable magnitude that occurred in the vicinity, such as *M* 7.0 in 1943 and *M* 6.7 in 2000. In the K event, six earthquakes (M > 6.0) occurred in inland since 1920, but only one earthquake (1975 *M* 6.1) occurred near the event region. On the other hand, the Korean peninsula, including the *G* event region has been quite seismically stable land until *G* event - the largest event is only *M* 4.2 since 1905 and no inland events with estimated *M* > 5.2 for 270 years. Thus the duration period of seismic silence also strongly correlates with the difference of Q_S^{-1} between *BEP* and *AEP*.

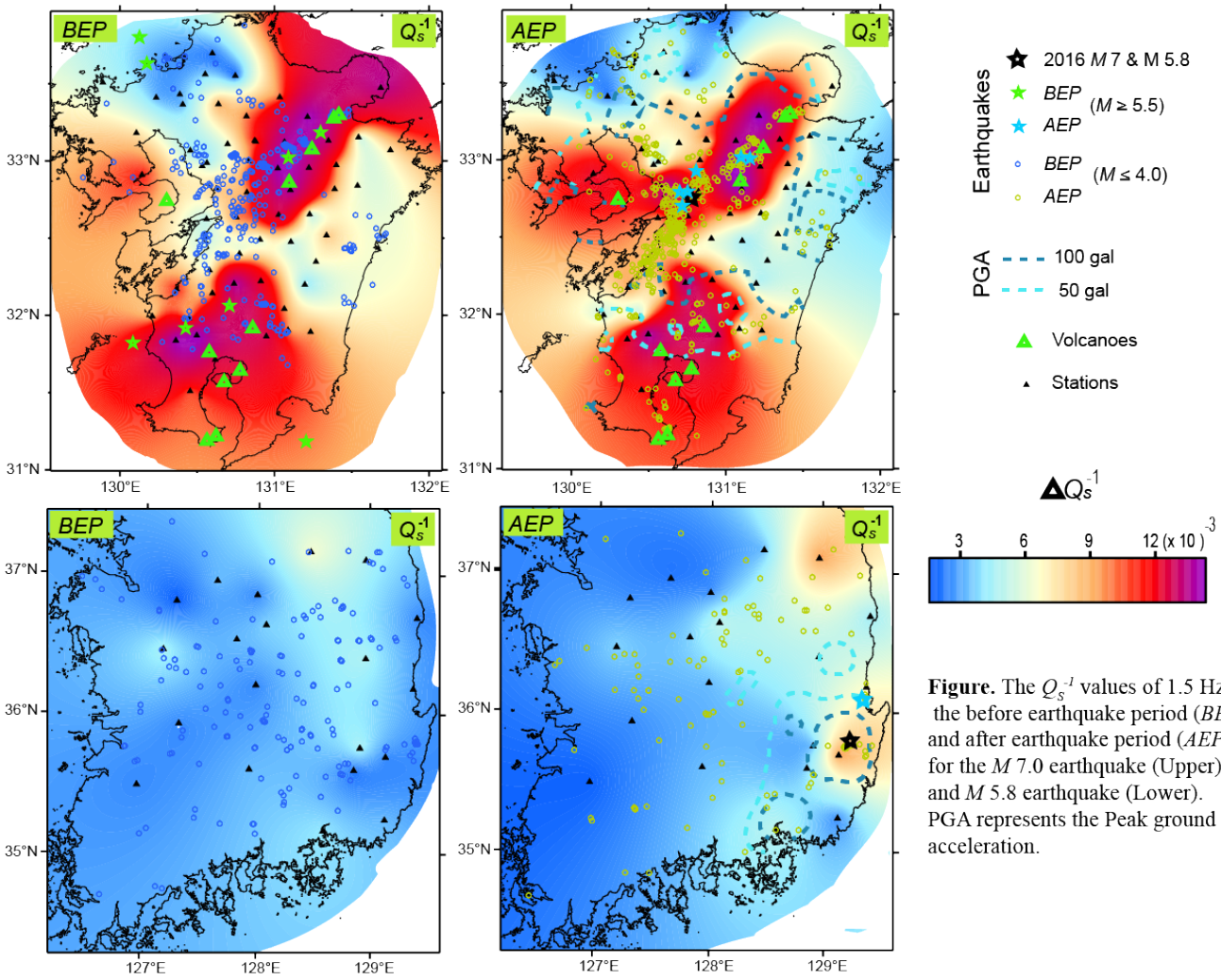

Figure. The Q_S^{-1} values of 1.5 Hz in the before earthquake period (*BEP*) and after earthquake period (*AEP*) for the *M* 7.0 earthquake (Upper) and *M* 5.8 earthquake (Lower). PGA represents the Peak ground acceleration.