Intraplate Seismicity, Quaternary Fault and Seismic Hazard in the Korean Peninsula

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Abstract:

The Korean Peninsula is part of the Eurasian Plate and lies between the seismically active China and Japan, It shows long term intraplate seismicity. The level of seismicity is relatively lower with moderate sized earthquakes than that in neighboring parts of Northeastern China and Japan. Korea has abundant historical earthquake records covering the last two millennia. Even though the records of large size events are only remained as we go back to the past. Instrumental observation of earthquakes in Korea started in 1905.

There are several compilations of historical earthquake records in the Korean peninsula (e.g. Wada, Y.; 1912, KINS, 1998; Lee and Yang, 2006; Kyung, 2011). We obtained almost 2100 events and re-estimated the earthquake epicenter, Modified Mercalli intensity by applying simple rules to the data set.

The Korean peninsula was in active period from 1500 through 1750 and then remained quiet until the beginning of the twentieth century. In various historical records, earthquakes caused houses, fortresses, smoke signal towers and rocks to collapse. Also, soil liquefaction, foundation crack, ocean acoustic waves and coastal zone flooding were reported. The destructive seismic event in Gyeongju caused great damage and killed approximately 100 people in March 779.

The northern part of Korean peninsula is less likely to experience earthquakes while the southern part is believed to be relatively active. The most powerful earthquakes rocked the Kyongsang basin and coastal zones along the East Sea, especially in and around Gyeongju. Since 1900, Koreans have witnessed this pattern again, as being evidenced by Gyeongju earthquake (M 5.8) on September 12, 2016. The large earthquakes are well associated with the major active faults in inland area,. Especially, the NNE-SSW trending Yangsan fault and NNW-SSE trending Ulsan fault is the main target for recent study. Responding to the increasing public concerns over the bigger seismic events, South Korean government launched a 20-year project for survey and evaluation of active faults in 2017.

A probabilistic seismic hazard map of the Korean Peninsula was made based on the long term historical and instrumental seismicity data reflecting the seismo-tectonic characteristics by applying USGS program (Harmsen (2008). The program was partly modified for the input data such as areal sources and attenuation formula. The uncertainty of input parameters given by specialists was reflected in the calculation of the seismic hazard values by logic tree method. The general pattern of Peak Ground

Acceleration (PGA) is quite sensitive and similar to the shape of areal source. The probabilistic seismic hazard map shows the contour distribution of peak acceleration (%g) with 10 % probability of exceedance in 5, 10, 20, 50, 100, 250, and 500 years. The result shows that the peak ground acceleration (PGA) values of the northern peninsula is almost half those of the southern peninsula except Hwanghae province. The general trend of the hazard map extends in the direction of NW-SE from Whanghae province to south-eastern regions of the peninsula. The values in the northern part of Kangwon province is relatively lower than other areas in the southern peninsula. The PSHA maps are considered to be a valuable data for the seismic safety regulations for the major facilities such as nuclear power plants in Korea.

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