Space-time Analysis of Volcanic Eruptions and Disasters in Japan for the Past 2,000 Years

Yoichi Nakamura, Yuhtaro Ito, Masato Tazawa, Mika Suzuki

Utsunomiya University, Japan

E-mail: ynakamu@cc.utsunomiya-u.ac.jp

Historic records of volcanic activities and disasters provide very useful lessons for disaster mitigation planning. Every historic document ever recorded in Japan dealing with volcanic disaster events has presently been re-surveyed and verified. Records have been obtained for a total of 1,162 eruptions over the past 2000 year for 110 active volcanoes. The 47 active volcanoes newly designated for constant monitoring by the Japan Meteorological Agency (JMA, 2011) account for 87% of all the eruptions. By reviewing documentation and referring to published data, values of the Volcanic Explosivity Index (VEI) for approximately 90% of the eruptions recorded could be evaluated. VEI 1 and 0 eruptions were recorded only during the most recent 100 and 50 years, respectively. The numbers of VEI 2 and 3 are mostly distributed over the past 500 years, with VEI 3 numbering the highest. Present results for the past 2000 years in Japan are generally similar in tendency to the world data for the past 10,000 years reported by the Smithsonian Institution (2010). However, there have been no VEI 6 and 7 eruptions recorded in Japan.

Using the frequency-distribution analyses for eruptions as a function of VEI value, we have obtained the average frequency for each level of VEI. VEI 5 eruptions occur approximately once every 180 years, and VEI 4 eruptions occur once every 50 years with some fluctuations. VEI 3 and VEI 2 eruptions occur approximately once every18 years and 4 years, respectively, but with somewhat larger fluctuations. After the space analysis, we obtained a regional view of volcanism in Japan. Kyushu is the most volcanic active area and after Kyushu, Kanto-Chubu, Izu-Mariana, Hokkaido, and Tohoku, in that order. However, larger VEI 4 and 5 eruptions tend to occur in Hokkaido. After the results were summed up by numbers of casualties, human and physical damages due to volcanic disasters, excluding deaths not directly related to the eruptions, e.g. starvations or epidemics, there were approximately 20,000 victims over the past 2,000 years. Over 80% of the deaths were due to volcanic tsunami, followed by deaths from lahars, including mudflows or debris flows, pyroclastic falls, debris avalanches, and pyroclastic flows. The highest number of victims per an eruption was due to volcanic tsunami and debris avalanche, although these are very infrequent.

After performing present space-time analyses for eruptions and volcanic disasters over the past 2000 years in Japan, specific and available data could be obtained and useful information-resources for volcanic disaster mitigation could be provided. We expect local decision-makers, administrative officials of disaster mitigation organizations and academic researchers to use these present results effectively to propose robust counter-measure strategies to implement when future volcanic events occur.