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Interaction between volcanic eruptions and earthquakes

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Analyses of historical and/or recent data catalogs of earthquakes and volcanic eruptions indicate that large earthquakes with a magnitude of about 7.5 can trigger new eruptions at some volcanoes that are located within a distance of about 100-200 km from the large earthquake (Linde and Sacks, 1998; Manga and Brodsky, 2006; Nishimura, 2017). This is probably because the strong motions and/or large deformation caused in the crust and volcano edifice stimulate the magma beneath the volcanoes to migrate upward. It is also well known that some significant earthquakes or earthquake swarm occur, being associated with eruptive activities. The present study clarifies the relationships between eruptions and nearby earthquakes by examining recent reliable global data bases. Centroid Moment Tensor (CMT) solution earthquake catalog from 1976 to 2015 by Columbia university and catalog of eruptions by Smithsonian Institute for the period from 1981 to 2010 are analyzed. Because of detection abilities of eruptions and earthquakes, eruptions with a VEI of larger than or equal to 2 and earthquakes with a magnitude of larger than or equal to 4 are examined. The results show no significant change for the moderate earthquakes occurring at a distance more than 50 km from the volcano. While significant changes are observed for moderate earthquakes occurring within a 50 km from the volcano: New eruptions sometimes trigger a moderate earthquake; when an eruption ends, the occurrence rate of moderate earthquakes increases for a few tens of days; the occurrence rate of moderate earthquakes increases for about three years for an eruption that continues for more than about one month. Simple numerical tests using random data indicate that these observed increases of occurrence rates are statistically significant. These results strongly suggest that the volcanoes interact with the tectonic earthquake that are closely located.