

Triggering of volcanic eruptions: stress transfer by large earthquakes

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It is often said that large eruptions may trigger new volcanic eruptions. Previous studies using historical data as well as recent observation results indicate that volcanic eruptions likely occur within a few days of the occurrence of large earthquakes locating close to the volcanoes (e.g., Linde and Sacks, 1998; Manga and Brodsky, 2006). However, historical data may be biased or disturbed by human activity such as world-war II. Triggering mechanism is also discussed at several volcanoes with the crustal stress changes generated by large earthquakes that may introduce magma upward migrations, but systematic research has not yet been done. The present study, therefore, analyzes recent reliable data of large earthquakes and volcanic eruptions to obtain empirical relations between the large earthquakes and volcanic eruptions. Global CMT catalog from 1976 to 2010 and Smithsonian data base of volcanic eruptions from 1966 to 2015 are used for the analyses. Large earthquakes with a magnitude of ≥ 7.5 are selected after removal of aftershocks of other large earthquakes, and volcanic eruptions nearby the large earthquakes are searched. The results show that occurrence rate of volcanic eruptions at volcanoes located within 200 km distance from large earthquakes increases about 50 % after the occurrences of large earthquakes. The large earthquakes with $M \geq 7.5$ and locating 200 km far from the volcanoes or with $M \leq 7.5$ do not affect the occurrence rate of volcanic eruptions. The volcanic eruptions occurring within 5 years after the occurrences of large earthquakes with $M \geq 7.5$ at a distance of less than 200 km are further analyzed to examine whether the volcanic edifice are compressed or dilated by the large earthquakes. The results show that about 60 % of the volcanic eruptions occurred at volcanoes that are subject to dilatation after the large earthquakes. However, almost same percentages of the eruptions occurring before the large earthquakes are located at the dilated regions. Not only the dilatation that may lead gas bubble nucleation and growth in magma to get buoyancy force, but also the contraction that may squeeze up the magma may be the mechanisms to trigger new eruptions at volcanoes nearby large earthquakes.

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