

SVC047-10

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Source mechanisms of vulcanian eruptions at Semeru volcano, Indonesia, as inferred from seismic and tilt data analyses

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We analyze tilt records and broad-band seismic signals preceding or associated with vulcanian eruptions observed at the summit of Semeru volcano, Indonesia. Signals from a tilt meter (701-2 Applied Geomechanics) and a STS-2 seismometer (Streckeisen Ltd.) installed at a depth of 1 m are recorded at a temporal station located at about 500 m north from the active crater. More than 1000 explosions are well recorded on March and April in 2007. To know how the volcano inflation changes with eruptions, we examine temporal changes and amplitudes in tilt and seismic signals. We first classify the magnitude of each explosion into five categories according to the maximum amplitude of the velocity seismogram of the explosion earthquake. Then, we stack the tilt signals, adjusting the time to the initial motion of the explosion earthquake, to obtain an average view of the volcano inflation. The stacked tilt records show that gradual uplifts toward the active crater start about 200 to 300 s before each explosion. The uplifts accelerate with time, especially about 60 s before the explosions. There is no significant dependence on the magnitude of explosion in these time scales. On the other hand, the amplitude of tilt increases with increasing the magnitude of explosion. This strongly suggests that we are principally able to predict the magnitude of explosion from the geodetic measurements. We further examine the broad band seismic signals of explosion earthquakes to obtain the average processes of vulcanian explosion. According to the maximum amplitude of the explosion earthquakes, we stack the vertical component signals that are low-pass filtered at 0.5 Hz. The averaged signals show downward motions for about 5 s followed by upward motions. The amplitudes of upward motions are much larger and longer. This means that the volcano first deflates, and then inflates. The source depths are not determined yet, but are maybe withdrawal of magma in the conduit, and rapid supply or expansion of magma remained in the conduit. Although the stacked signals change about 6-8 times in amplitudes, we do not see any significant differences in the temporal changes. These tilt and seismic data analyses indicate that the vulcanian explosions repeatedly occurring at Semeru volcano are mainly different in the magnitude, but not in time scale.

Keywords: Vulcanian, explosion, tilt, explosion earthquake, inflation, deflation