Characters of air waves associated with volcanic eruptions of Sakurajima Volcano during 2001-2007

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Since 1980s, Sakurajima Volcano Observatory has monitored atmospheric pressure changes accompanied with eruptions of Sakurajima volcano using a low frequency microphone. The microphone was installed at a distance of 5.6 km away from the summit crater. The eruptions on 1980s were typically accompanied by strong air waves (20-500 Pa in 1985-1988; Iguchi and Ishihara, 1990), however relatively weak air waves has been observed since 2001 (less than 80 Pa). We rechecked these recent records during 2001-2007 in order to identify the characters of air waves.

Two types of air waves were observed in these periods of 2000s as results, one was an explosion-type (E-type) wave and the other was two-peaks-type (TP-type) wave. These two types of air waves were basically corresponding to the eruptions accompanied by explosion-type earthquakes and BL-type earthquakes, respectively. The former E-type air wave has been reported by many researchers previously which have a waveform mainly composed of two phases: an impulsive compression phase and a subsequent rarefaction phase with a longer duration. After these two phases, there were some sets of pressure oscillations going back to the ambient pressure before eruptions within 10 sec. Amplitudes of the first compression phase of E-type were ranged from 0.4-80 Pa. The E-type air wave was caused by the outburst of a gas pocket beneath the crater (LP phase of explosion earthquake; Tameguri et al., 2002). On the other hand, the TP-type wave has a character of the conspicuous second peak of a positive pressure which appeared 1.5-1.8 sec after the first set of compression and rarefaction phases (0.1-15 Pa). It was clear that this second positive phase was not the part of the oscillations towards ambient states of atmospheric pressure described above. Pressure ratio of the second peak for the first peak (P_2/P_1) was ranged from 0.5-3.4 and this ratio slightly increases with a decreasing P_1. We think that this second positive phase would be generated by ejection of volcanic cloud which is accelerated with in the conduit after the disruption of a gas pocket. Except for the existence of this second peak, no significant difference in the waveform was recognized. For example, the duration of the first compression phase is almost same; 0.16-0.40 sec for E-type and 0.18-0.49 sec for TP-type. These durations tended to shorter as increasing of amplitude of the first peak (P_1) for both types of waves. Clear differences in the pressure ratio of the first compression phase for the rarefaction phases ($|P_{1-}/P_{1+}|$) also could not be observed, ranging 0.5-1.75. This suggests that similar phenomenon as outburst of a gas pocket would be occurred at eruptions and it would bring about the first phase of air perturbation (E-type wave's component: some sets of a compression and a rarefaction phases) which was able to be seen in both types of air waves. And then, no significant second peak on E-type air waves would be due to the larger amplitude of E-type wave's components which was concealing a weak air pressure perturbation of volcanic clouds' ejection.