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Airwaves generated at Asama Crater since the eruption of February, 2nd, 2009

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At the summit crater of Asama volcano, a small eruption occurred on February 2nd, 2009, and a new mouth with a diameter of 50 m was formed near the center of the crater bottom. Since then, gas emission from the mouth continues. We made observations of acoustic waves in infrasonic and audible ranges at the edge of the crater. Here, we present the results of the acoustic wave analyses and refer to other multi-parameter observations such as seismic waves, images, and wind conditions.

[Infrasonic wave observation at the summit crater of Asama]

Volcano Research Center at ERI maintains two permanent stations at the crater, KAE in the east and KAW in the west. A continuous monitoring for infrasonic waves at KAE started in August 20 08, using a broad-band microphone (Bruel & Kjaer, 4193+UC0211, 0.1Hz-10kHz) with a sampling rate of 100 Hz. In order to reduce the wind noise, the microphone is connected to the atmosphere through three 2m-long tubes having different orientation. However, this system turned out to have disadvantages: the resonance affects the low frequency range which is the target of the observation. On January 31st, the signal amplitude suddenly decreased and the high-frequency components disappeared. It was inferred later that this had been caused by snow or ice choking the tube. This system was taken away on April 30th. Since 10th of June, 2009, a new low-cost infrasonic sensor has been set within the observation shelter without any tubing system. It has been confirmed that this sensor, which has been developed by a research group of Firenze University, has a similar response with the Bruel & Kjaer microphone in the frequency range of 0. 3 Hz-6 Hz. On August 4th, another sensor of the same type was set at KAW station.

[Results of the continuous monitoring of infrasound]

After the eruption on February 2nd, 2009, several eruptions were noticed by the video records, ash fall in the village, or seismic signals. We found that all these activities were accompanied by observations at KAE of correlated infrasound and seismic signals. We infer that this correlation is generated by coupling of the airwave and the ground motion with effects of local topography. The correlation analyses are useful in detecting the crater activity. Although for most of the cases it is difficult to determine the onset of the infrasound or even to distinguish the volcanic signal from the wind noise on the waveform, the correlation analyses enable us to determine the onset clearly. It is found that the onsets of the infrasound are behind the onsets of VLP events by variable times from nearly zero to longer than 5 minutes.

[Audible sound observations]

The sound recording was performed on May 11th and 26th, 2009, near KAW. Two digital

recorders (Sony PCM-D50) were used. It has been confirmed that the frequency response of this recording system is almost equivalent to the Bruel & Kjaer microphone from 2 Hz to 10 kHz. The roaring sound from the crater has a characteristic power-law spectrum with a kink at 775 Hz. Based on this feature, the occurrence of the roaring sound has been detected from the sound data. It is found that in the case of May 11th, the roaring sound was intermittent and occurred in correlation with a VLP event and a plume emission from the crater. The onset of the sound was about 10 seconds behind the onset
of the VLP. In the case of May 26th, on the other hand, the roaring sound was continuous, while the VLP events and plume emissions were as intermittent as before.

[Future works]

The infrasound and audible sound associated with the crater activity at Asama have characteristic structures in their spectrum. The future goal is to understand mechanisms generating these features. We also plan to start a broadband continuous monitoring of the airwaves at the crater.

Keywords: airwave, sound wave, volcano, tremor, eruption, gas emission