The visible movie of volcanic pressure waves

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Recently, many volcanologists referred the importance of pressure waves induced by volcanic explosions and tried to get the information of explosion mechanism based on this phenomenon. There are, however, few observations have been made within one kilometers from the explosion source. As the distance of observation from the explosion source increases, the pressure wave changes into acoustic waves or infrasonic waves. These waves lose their important information that should be contained originally. This means, if we wish to get the information on the dynamics of volcanic explosion, we have to observe the pressure waves before its subsidence; few tens to hundreds meters from the crater. Hence, if we are able to visualize the volcanic pressure waves near explosion crater, it must be an effective tool to understand the explosion dynamics.

The eruption on Nov. 21 at Izu-Oshima was such the case. This eruption produced many explosions accompanied by flashing arcs; they were visualized volcanic pressure waves due to the phase change of H2O in the air. To understand the explosion mechanisms, we made a numerical simulation of pressure disturbances firstly and confirmed spatial and temporal distributions which clouds will appear. This simulation was used a spherical explosion model that contained the finite size of explosion source. By applying the movies of flashing arcs, we could propose the physical condition within the explosion source. It was found that the explosion occurred by the busting of high-pressurized bubble with H2O of about 15 m in diameter. This bursting had 3.2*10^9 J in explosion energy, and occurred just beneath the surface of lava-lake. These estimated values were also examined using the scaling laws established by field explosion experiment, and tensile strength of magma and the effusion rate.

The flashing arc of Izu-Oshima 1986 eruption is the example of naturally visualized volcanic pressure wave. Furthermore, we have already succeeded in the visualizing the pressure wave directly through the density change in the air in the filed explosion experiment using high-speed camera movies. This suggests that a high-speed camera with high resolution will be an effective tool for the understanding of volcanic explosion in a near future.

In this presentation we will also show the radiation phenomenon at Aso volcano on 1989 if time permit.