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Relation between lava dome growth and degassing during the 1991-1995 eruption of Unzen Volcano

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The 1991-1995 eruption of Unzen volcano was not explosive, but was the effusive lava dome formation activity. The reason seems to be because the degassing was efficiently carried out. H2O discharge rate has been estimated at 83 kg/s from SO2 flux measured by COSPEC and composition of the high-temperature volcanic gas collected at the foot of lava dome (Hirabahashi, 1995). In the meantime, H2O discharge rate was estimated at 330 kg/s from effusion rate of lava and water content of magma. H2O discharge rate required from SO2 flux is clearly less, and the problem of how this difference is explained, has been left. On this fact, there is an idea of H2O escaping from the conduit wall to the volcano body, as Wood and Koyaguchi (1994). Fukui (2001) analyzed the video image, and evaluated the heat energy discharged by volcanic plume. The formation process of the volcanic cloud was modeled, and emission rate of the magmatic water was estimated. This H2O discharge rate is consistent with the H2O discharge rate estimated from the effusion rate of lava and the water content in magma, and it was shown that H2O in the magma was discharged as a volcanic smoke from lava dome. The difference from H2O discharge rate estimated from the COSPEC observation shows that SO2 rich gas and the H2O rich gas discharged separately. Actually, it was observed that the white plumes were discharged over the surface of lava dome, though the bluish volcanic gas rich in SO2 was discharged concentrated from the Jigokuato vent. SO2 is discharged from the magma reservoir. In the meantime, H2O separated from the magma at the upper part of conduit, and it seemed to discharge it through the crack in the lava dome. It was imagined, because the low-frequency earthquake was arising in the upper part of the conduit or within the dome.

In this research, the relation between lava dome growth and degassing activity is discussed from detailed temporal variation of heat discharge rate.

Heat discharge rate was estimated from the video image data of the volcanic cloud using the plume rise method (Kagiyama, 1978). Mainly, video image data of monitoring camera installed at Fukae (SE 6.5km of the lava dome) was utilized. The image of Sugitani camera (NE 4.7km) and Futtsu camera (SSE 9km) was also used depending on the wind direction. The volcanic ash clouds with pyroclastic flow were removed from sample.

The heat discharge rates have the two pulses (the peaks are summer of 1991 and summer of 1993) same as the effusion rate of lava (Nakada et al., 1999) and SO2 flux (Hirabayashi et al., 1995). SO2 flux and H2O discharge rate also shows the good correlation on the effusion rate of lava, and it is shown that the degassing was efficiently carried out at least by the end of 1993.

The detailed temporal change of flow speed, thickness and height of lava dome has been obtained from video image from Nodake (SW 2.4km), theodolite observation, and photographic observation (Fukui, 1993). The flow speed of lava reflects the effusion rate of lava approximately. The flow speed was increased in the new lobe appearance, and it gradually decreased afterwards, and the aspect that the new lobe appeared was shown, when it sufficiently decreased. However, such tendency could not be recognized in the second and third lobe. There is some a similar time change at heat discharge rate. However, heat discharge rate is small immediately after the new lobe appearance. Therefore, the relative rich volatile remains in the lava of this stage. This recieves a support from that the height of ash cloud with pyroclastic flow immediately after the new lobe appearance was large.