About the influence of the ground water on the formation of high temperature fumarole

Nobuo Matsushima[1]

[1] G.S.J

As previous study, we indicated that the development of the hydrothermal system in the Satsuma-Iwojima volcano is caused by the degassing of magma which is intruded at shallow level (Matsushima, 2008). The study concluded that the degassing occurrs above ground water level because the ground water level keeps the development of the hydrothermal circulation within the water saturated layer. This conclusion is consist with the observations that the pressure of degassing is estimated to be lower than 20atm (Saito et al., 2002) and the volcanic gas at summit area is mainly of volcanic origin (Shinohara et al., 2002). The hot spring activity at the coast, which is remarkable feature of Satsuma-Iwojima volcano, is developed by the combination of the down flow of condensed volcanic gas within the mountain and hydrothermal circulation under the ground water level. This conclusion consists with the observation that hot spring water contains a water of volcanic origin at the rate of a few percent (Kazahaya, unpublished data).

The example of Satsuma-Iwojima volcano shows that the magma degassing above the ground water level induce the high temperature fumaroles at the summit area. When the degassing occurs under the ground water level contrary to the case of Satsuma-Iwojima volcano, the fumarole activity at the summit would vary according to the degree of the mixing between the volcanic gas and the ground water. The condition was studied by the numerical simulation for the typical model in which the volcanic gas ascends the high permeability vent from magma to the surface. The result shows that the mixing occurs at the base of the vent because the pore pressure gradient is smaller than the surrounding hydrostatic pressure and the ground water infiltrate into the vent. If the degassing rate is constant, the degree of the mixing depends on the permeability of the formations. The high permeability of the vent, as well as the high permeability of the surroundings, results in the high degree of the mixing because the pore pressure gradient of the vent becomes small. The degree of the mixing is also influenced by other conditions such as the degassing rate and degassing depth.

For the example of the degassing under the ground water level, we consider the fumarole activity which developed at the summit area just after the 1986 eruption of Izu-Oshima volcano. The volcanic gas contained the ground water at the rate of 50% in average although the rate showed the temporal variation (Kazahaya et al., 1993). The degassing rate, degassing depth and permeability are considered as parameters of the numerical simulations of the hydrothermal activity.