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Chemical and isotopic composition of fumarolic gas at Mihara volcano, Izu-Oshima Island, Japan

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1. Introduction

Since the late of 19 century, Izu-Oshima volcano has erupted periodically every thirty to forty years. During the last eruption in 1986, a lave flow issued on the flank of volcano resulting in the evacuation of all residents in island. For the mitigation of volcanic hazard, early warning is needed. As volcanic gases move quickly in crust, the composition of fumarolic gases may change responding the activation of magmatic activity. According to Suwa and Tanaka (1959), increases of outlet temperature were observed at some of fumaroles. Sano et al. (1995) detected a quick increase of 3He/4He ratio in vapor discharged at a bore hole on the volcanic flank following the eruption in 1986. Shimoike and Notsu (2000) observed the change in CO2/H2O ratio of vapor at the bore hole. The ratio decreased gradually after the eruption in 1986. The above results indicate the close relationship between the composition of gas and volcanic activity.

2. Observation

Since 2004 two fumaroles (X-15 and K) have been the subject of observation until. X-15 and K are located near the central pit crater of Mt. Mihara. X-15 and K are located at the west and east of the crater, respectively. The outlet temperature of fumarolic gas, CO2/H2O ratio and isotope ratios (dD and d18O) have been measured periodically along the method by Ohba (2008).

3. Result

(X-15) The outlet temperature of X-15 had been about 65C until 2008 then decreased to 62C in 2011. The CO2/H2O ratio has been variable, which may be due to the low density of H2O vapor and the sampling of H2O was not complete. The isotope ratio of H2O decreased in 2011. No smell of H2S and SO2 were felt.

(K) The fumarolic gas at K has been discharged on the inner wall of crater. The flux of fumarole is significant within the fumaroles on summit area of Mt. Mihara. The fumarolic gas can be noticed at a place 2 km far from the fumarole. The outlet temperature of K was stable, within the range of 77 to 79 C. The CO2/H2O ratio was also stable within the range of 0.02 to 0.03. The isotope ratio of H2O was slightly higher than that of H2O at X-15. The isotope ratio of H2O at X-15 and K was lower than the ratios of local meteoric water at Izu-Oshima Island (Takahashi et al., 2000). No smell of H2S and SO2 were felt.

4. Factors controlling the composition of fumarolic gas

Ohba (2008) proposed a model for the formation of fumarolic gas at Mt. Mihara, in which, a magmatic gas enriched in CO2 is mixed with cold ground water, resulting in the generation of vapor phase. The vapor phase is diluted by a vapor derived from meteoric ground water. The diluted vapor phase is discharged at surface as fumarolic gas. A part of vapor was removed as a condensed liquid phase before the discharge at surface. If the flux of magmatic vapor increases, a high isotope ratio of H2O is expected. The CO2/H2O ratio is expected to decrease because the condensation of vapor phase would be suppressed prior to the discharge. The observed changes in the composition of fumarolic gas at X-15 and K are not compatible to the expected changes the case that the flux of magmatic vapor increases.

Keywords: Izu-Oshima, Volcanic gas, CO2/H2O, Isotope ratio, Fumarolic gas