Chemical and isotopic composition of volcanic gases at Mt Kirishima Iwoyama, Japan

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INTRODUCTION

At Mt Kirishima Iwoyama, several fumarolic gases appeared in the vicinity of the summit in December 2015, and the discharge of fumarolic gas was enhanced in May 2017. In addition, a small steam eruption occurred in April 2018. Volcanic gas contains components degassed from magma and is useful for evaluating volcanic activity. In this study, from December 2015 to January 2019, fumarolic gases were repeatedly collected and analyzed at Mt Kirishima Iwoyama. We consider the relationship between the variation of the chemical composition and stable isotope ratio of these samples and the recent volcanic activity.

SAMPLING OF FUMAROLIC GAS

Fumarolic gases a, b, c were collected near the summit of Mt. Kirishima Iwoyama. The location of fumarole-a is the place where fumarolic gas first appeared in Dec. 2015. The fumarole-b is located about 40 m south of fumarole-a. The fumarole-c is about 200 m away from the fumarole-a in the south-southwest direction. The outlet temperature of the fumaroles was all close to the boiling point of water and the discharge pressure of fumarolic gases was low.

RESULTS AND DISCUSSIONS

The SO2/H2S ratio of fumarolic gas-a fell sharply from May to October 2018, but again rose in January 2019. The ratio at fumarolic gas-b also rose from October 2018 to January 2019. The Oxygen isotope ratios of H2O rose at three fumarolic gases from October 2018 to January 2019. At all three fumarolic gases, the CO2/H2O and the H2S/H2O ratio fell from October 2018 to January 2019.

In general, CO2 is a component originating in magma, H2S is a component originating in hydrothermal system, and the CO2/H2S ratio rises as the flux of magmatic gas to a shallow hydrothermal system increases. In Mt Kusatsu Shirane and Mt Hakone, the H2S/H2O ratio of the fumaroles is stable in time, and the CO2/H2S ratio could be a good indicator of the magmatic gas flow rate for the shallow hydrothermal system. The H2S/H2O ratio of Mt Kirishima Iwoyama is variable, and the situation is different from Mt Kusatsu Shirane and Mt Hakone. For example, from January to March 2018, the H2S/H2O ratio of fumarolic gas-a changed little, but fumaroles b and c greatly decreased. From March to May 2018 the H2S/H2O ratio dropped greatly in fumarolic gas-a, but in fumarolic gas-c it increased in reverse. Thus, the change in H2S/H2O ratio was not coordinated between fumaroles, and the cause of H2S/H2O ratio change is estimtated to be local. For this reason, it is not appropriate to use the CO2/H2S ratio of fumarolic as an indicator of the flux of magmatic CO2 to the shallow hydrothermal system at Mt Kirishima Iwoyama. The reason why the H2S/H2O ratio of fumarolic gases greatly fluctuates may be

attributed to the insufficient development of shallow hydrothermal system.

The SO2/H2S ratio of fumarolic gas gas was low in January 2018, but it rapidly rose in March 2018 just before the steam eruption. In addition, the increase in SO2/H2S ratio occurred simultaneously in three fumarolic gases. At this time, the apparent equilibrium temperature (AETD) calculated by combining the hydrogen isotopic ratios of H2O and H2 sharply increased to values close to the magmatic temperature at the fumaroles-a and b. A similar increases in SO2/H2S ratio and AETD also occurred in May 2017, when the discharge of fumarolic gas was enhanced. The H2O oxygen isotopic ratios of the three fumaroles have been similarly fluctuated. The oxygen isotopic ratio reached the maximum value in fumaroles a and b in March 2018 just before the eruption in April. Considering the SO2/H2S ratio and the high oxygen isotope ratio in May 2017, it is highly likely that so-called the attempted eruption occurred.

