Mixing process of air and underground water into magmatic gas discharged from Kuju-Iwoyama fumarolic area of Kuju Volcano, Japan

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Hydrogen and oxygen stable isotopic ratios (dD and d18O) have been used as a good indicator of the origin of the discharged fumarolic steam from the active volcano, since the ratios have distinct values for the major sources of the waters: magmatic and meteoric. There are numerous discussions of component sources and mixing relations of volcanic fumarolic steams (e.g., Mizutani et al., 1986 ; Kitaoka et al., 1996), however mixing process of fumarolic gas components hardly have been discussed. In order to understand the mixing process in enough detail, it seems to be necessary to treat not only hydrogen and oxygen stable isotopic ratios of the steam condensate but also geochemical data of fumarolic gas. The purpose of this study is to improve the understand in the mixing process of volcanic fumarolic gas with respect to the isotopic and geochemical data.

Steams and gases discharged from fumaroles in Kuju-Iwoyama fumarolic area of Kuju Volcano, central Kyushu, Japan were collected in August and October, 2000 and May, 2001. Stable isotope ratios of hydrogen and oxygen of the steam condensate samples showed that the fumarolic steams were mixtures of magmatic steam and local meteoric water. From the quantitative estimation by means of the dD and d18O values and He/Ar ratios of the fumarolic gases, the proportion of mixing for the three end-members: magmatic fluid, air, air-saturated water (ASW) was estimated to be 1 : 7.6-15.1 : 0.0009-0.0043. This relative proportion and a linear relationship between the delta-values (dD and d18O) and He/Ar ratios of the fumarolic gases strongly suggest that underground air and underground water can be treated as the vadose air and the vadose water, respectively. Consequently, the fumarolic fluid of Kuju-Iwoyama would be formed by the mixing of the vadose fluid (vadose air and vadose water) and the magmatic fluid into the fumarolic gas conduits within the vadose zone.