

Fumarolic and mofette gases of Kusatsu-Shirane volcano

Yuji Katabuchi[1], Takeshi Ohba[2], Jun-ichi Hirabayashi[3], Kenji Nogami[4], Kazushige Nakamura[5], Michiko Ohwada[5]

[1] Volcanic Fluid Research Center, T.I.Tech, [2] Volcanic Fluid Research Center, Tokyo Institute of Technology, [3] VFRC, Tokyo Inst. Tech., [4] Kusatsu-Shirane Volcano Obs., TIT, [5] Volcanic Fluid Research Center, Tokyo Inst. Tech.

<http://131.112.25.6/indexJ.html>

INTRODUCTION

Kusatsu-Shirane volcano has several active fumarolic areas and many altered areas where low-temperature H₂O depleted volcanic gas (mofette gas) is discharging. Although mofette gas caused fatal accidents at Mt.Hakkoda and Mt.Adatara, the chemical and isotopic composition have not been studied well. In this study, fumarolic and mofette gas were collected and analyzed. Using these data, we discuss the hydrothermal system of Kusatsu-Shirane volcano.

OBSERVATION

In 2000-2001 we collected 19 fumarolic gas samples from a fumarolic area on the eastern flank (Sesshougawara) and analyzed chemical composition, D/H, 18O/16O, isotope ratio of H₂O, 13C/12C ratio of CO₂ and 34S/32S ratio of H₂S and elemental sulfur deposited around the each fumarole. In 2001 we collected mofette gas on the east, southeast and west of the flanks of volcano. The chemical composition, 13C/12C ratio of CO₂, 34S/32S ratio of H₂S and nature sulfur deposited around the mofette were measured.

RESULT

The (H₂S+SO₂)/He ratios of fumarolic gases showed a positive correlation with the 34S/32S ratios. The d13C values of fumarolic CO₂ ranged from -2.8 to -4.0 permil. The H₂S/CO₂ ratios of fumarolic gas and mofette gases from the west flank were 1.10 to 3.33, and 0.78 to 3.33 respectively. The ratios of fumarolic and mofette gases from east, southeast flanks were 0.30 to 0.92, and 0.08 to 0.48 respectively. In the eastern fumarolic area (Sesshougawara), the H₂O, CO₂, H₂S ternary composition showed a local variation, namely, the H₂S fraction are almost constant, but the CO₂/H₂O ratios are variable. A similar trend is seen in the temporal variation of the gas from a fixed fumarole in Sesshougawara and also the fumarolic gas from northern flank.

DISCUSSION

The d13C of fumarolic CO₂ are almost invariable except some samples and consistent to the d13C of magmatic CO₂, -3.2 permil suggested by Sano et al (1994). The d13C of mofette gas, -2.7 permil is slightly higher than the d13C of fumarolic gas. As the mofette gas is thought to be generated from a fumarolic gas, where H₂O was lost due to condensation during cooling. The d13C of CO₂ mofette gas may be increased in this process. Comparing the H₂S/CO₂ ratio of mofette gas with fumarolic gas, mofette gas could be generated from a fumarolic gas whose composition is identical to the fumarolic gas closely located to the mofette. In the chemical composition of mofette gas from west flank, a large variation was found in the H₂S/CO₂ ratio. The variation could be due to the selective H₂S dissolution to a surface water. Assuming that the amount of He is constant during the ascent of gas, positive correlation between (H₂S+SO₂)/He and 34S/32S ratios of fumarolic gas in Sesshougawara suggests that the process of elimination of H₂S and SO₂ decreased 34S/32S ratio of gas. However, the local variation found in the fumarolic gas from the Sesshougawara cannot be explained by the elimination process. The variation could be explained by a mixing of a gas with low H₂O content, lower H₂S/CO₂ ratio and a gas with high H₂O content, higher H₂S/CO₂ ratio. The former gas would be a deep volcanic fluid. The latter gas could be a hydrothermal gas generated by a reaction between native sulfur at depth and a heated meteoric groundwater.