

The chemical composition and isotopic ratios of the volcanic gases from the Jigokudani Valley, Tateyama Volcano

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Tateyama Volcano located in the northern part of the Hida Mountains has an active geothermal field called the Jigokudani Valley (JV). The recent state of the hydrothermal system in the JV was clarified by the resistivity structure and the geochemical analyses of hot-spring waters (Seki et al., 2016), but comprehensive studies on volcanic gases have not been conducted for a long time. The last study was reported by Mizutani et al. (2000), in which the geochemical analyses were performed for the fumarolic gases sampled in 1991. The chemical and isotopic compositions of fumarolic gases are sensitive to changes in the volcanic activity because of the high mobility within a pathway from deep-seated magma to the ground surface. Therefore, it is necessary to examine the geochemistry of volcanic gases for a better understanding of the whole magma-hydrothermal system in addition to the hot-spring water analysis. Fumarolic gases in the JV were sampled at 7 sites in 2016, and the chemical compositions and the isotopic ratios of water and helium were analyzed in order to clarify the magmatic hydrothermal system of JV. The measured fumarolic temperatures showed from 91.6 to 113.6 °C, most of which are higher than the boiling point of water in this area. The isotopic ratios of waters from the fumarolic gases showed the values lighter than hot-spring waters. We found that the fumarolic gases containing HCl were discharged only in the highly active geothermal area of the JV, where the compositions of the hot-spring waters showed high Cl⁻ concentration (~20,000 ppm). In addition, the fumarolic gases showing high H₂S/SO₂ ratios were sampled in the areas where the hot-spring waters were mainly composed of SO₄²⁻ containing almost no Cl⁻, which indicates that SO₄²⁻ in the SO₄-type hot spring is derived from the oxidation of H₂S. ³He/⁴He ratios of the volcanic gases from JV were from 6.8 to 7.7 R_A, which indicates that He was derived from magmatic origin. The ³He/⁴He variation is predominantly controlled by the different degree of atmospheric contamination to the common magmatic He component, as the air-corrected ³He/⁴He ratios based on ⁴He/²⁰Ne ratios are almost constant (7.5 ± 0.2 R_A). In the presentation, we will report the further results of analysis of volcanic gases and the model of the hydrothermal system beneath the JV will be updated.

Keywords: Tateyama Volcano, Hydrothermal system, Fumarolic gases, Stable isotope ratio