Hydrothermal system beneath the Jigokudani valley, Japan

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An understanding of the hydrothermal system is essential to clarify the mechanism of preatic eruption because phreatic eruption occurs in the hydrothermal system developed within a volcanic edifice. The Jigokudani valley of Tateyama volcano, Japan, was formed by repeated preatic eruptions some 40,000 years ago, and has an active solfatara field. We analyzed hot spring water of the Jigokduani valley to clarify what happens in the hydrothermal system. We measured electrical conductivity (E.C.), temperature, and pH of hot spring water at 75 locations in 2014 and 2015. Hot spring water was sampled at 12 sites in 2014 and at 15 sites in 2015, six of which were sampled at the same locations. Anion components (Cl^- and SO_4^{2-}) and the isotope ratios (water and sulfur) of hot spring water samples were measured. The hot spring water in the Jigokudani valley showed temperature more than 60 ˚C and strong acidic properties (pH < 3). The hot spring water in the Jigokudani valley was classfied into following three types: (1) The hot spring with high ion concentration ($Cl^- + SO_4^{2-} > 10^4$) and high isotope ratio near the magmatic water. The Cl^-/SO_4^{2-} concentration ratio showed about 1. (2) The hot spring with low ion concentration ($Cl^- + SO_4^{2-} \sim 10^2$) and low isotope ratio near the local meteoric water. This type of hot spring water was a lack of Cl^- concentration and was mostly composed of SO_4^{2-}. (3) The other hot springs showing the isotope ratios between magmatic water and local meteoric water. As for this type, hot spring water samples of 2014 showed high Cl^-/SO_4^{2-} concentration ratio ($Cl^-/SO_4^{2-} > 5$). However, the proportion of SO_4^{2-} of 2015 samples relatively increased because the Cl^- concentration decreased while the SO_4^{2-} was kept nearly constant. The origin of (1) and (3) is considered to be the liquid phase and the vapor phase of hydrothermal system when the magmatic hydrothermal fluids were separated into each phase at a shallow level, respectively. (2) was derived from the surface water supplied with volcanic gases consisting of H_2S. The 3-D resistivity structure of the Jigokudani valley was inferred by Seki et al. (2016), which found a gas reservoir beneath the Jigokudani valley and a hydrothermal system developed in the depth to 500 m. All hot spring water was estimated to be formed in those regions.