

Volcanic supply processes at Tokachidake volcano deduced from geochemical studies of fumarolic activity

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Tokachidake is one of the continuously degassing volcano, where the maximum plume height of the 62-2 crater often exceeds 500 m above the crater (JMA, 2013). The 62-2 crater, Taisho crater and Furikozawa, are the presently active fumarolic fields, followed different activity history. We will report the results of the geochemical survey started in 2003 and discuss processes and conditions of volcanic gas supply to the fumaroles.

The SO₂ flux of the volcano was 210/td in 2003 (Mori et al., 2006) and 400-500 t/d in 2014-2015. Fumarolic temperature of 62-2 crater peaked at about 500°C in 2000, then gradually decreased to less than 200°C after several years. In contrast, the apparent equilibrium temperature for the reaction of SO₂ + 3H₂ = H₂S + 2H₂O is almost constant at 300-400°C. Fumarolic temperature of Taisho crater fumaroles increased from about 200°C in 2000 to about 300°C in 2019. The apparent equilibrium temperature at Taisho crater slightly increased from about 300° to 300°C but is still lower than that at 62-2 crater. Fumarolic activity at Furikozawa declined after the 1988 eruption, has been at a low level until 2015, when reactivation started (JMA, 2019), and the maximum temperature of 420°C was recorded in 2019. The high-temperature gas is rich in hydrogen and show very high apparent equilibrium temperature of 560°C.

All fumarolic gases of Tokachidake, except of low-temperature, have a common feature of S- rich gases of 1-6 mol% S, but variation among each fumarolic field and time. For an example, H₂O/S mol ratios of Taisho crater fumarolic gases are almost constant at about 50 in 2008-2019, whereas the ratio of 62-2 gases decreased from 50 in 2008 to 20 in 2016. The H₂O/S ratio of the high-temperature gas of Furikozawa in 2019 was 16. Comparison of chemical compositions indicates that the recent 62-2 gas compositions are similar to the high-temperature Furikozawa gas, although temperature of the 62-2 fumaroles is on a decreasing trend, and distinct composition of Taisho crater fumarolic gases compared with the Furikozawa and the recent 62-2 gases. Similar feature can be observed in the variation of the hydrogen and oxygen isotopic composition of water. We will discuss processes and conditions of volcanic gas supply to these fumarolic fields.

Keywords: volcanic gas, fumarolic gas, Tokachidake