

Varying chemical and isotopic compositions of fumarolic gases from the summit and from the 1962-63 eruptive vents at Yakedake Volcano, Japan

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Since the latest phreatic eruption in 1962-1963, Yakedake volcano has remained dormant, but fumarolic activity around the summit area has continued steadily during the past hundred years. Recently, temperature, chemical, and isotopic compositions of fumarolic gases discharged from the summit fumaroles were ascertained for 2013-2017 (Saito et al., 2019). This time, fumarolic gases discharged from the 1962-63 eruptive vents, which locate about 300m north of the summit, were collected and chemical and isotopic compositions were analyzed. We compared our results from the 1962-63 eruptive vents with those from the summit fumaroles in order to evaluate the formation of volcanic hydrothermal system beneath the volcano.

Discharge temperatures of the fumaroles around the 1962-63 vents were 95-100°C: slightly lower temperatures than those from the summit fumaroles but higher than the boiling temperature at the elevation. Chemical analysis revealed that fumarolic gases from the 1962-63 vents contain lower amounts of SO₂ than the summit fumaroles. Higher CO₂/total S ratio and lower apparent equilibrium temperatures of the 1962-63 fumaroles coincide with lower discharge temperatures. On the other hand, the 1962-63 fumaroles show higher He/Ar ratio than the summit fumaroles, suggesting higher contribution of magmatic fluid.

The isotopic compositions of water (D, ¹⁸O) show that the fumarolic fluids from the summit fumaroles were probably formed by mixing of the magmatic fluids and local meteoric water. The isotopic compositions of the 1962-63 fumaroles show much lower values not only than the summit fumaroles but than local meteoric water, suggesting that the fluids suffered isotopic fractionation due to evaporation of the fumarolic gases.

Our results possibly indicate that volcanic hydrothermal system beneath the summit region differ from that under the 1962-63 vents.