

2004年浅間山噴火における地球化学的観測研究

—噴出物の水溶性成分の変動と火山活動—

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Geochemical Observation on the 2004 Eruption of Asama Volcano
through Analysis of Water-soluble Components on the Ash

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Monitoring of volcanic gases will provide us with important information on volcanic activity and contributes towards reduction of volcanic disasters. However, approach to an erupting volcano considerably involves danger. Analysis of water-leachates of pristine ash is also available for estimating composition of volcanic gases. It is a safe and effective method for monitoring of eruptive activity without having to use a particular equipment.

Asama volcano lies about 150 km northwest of Tokyo and it is one of the most violent volcanoes in Japan. After about 20 years dormancy, the three-months-long eruptive activity commenced on September 1, 2004 with vulcanian explosion. Non-explosive strombolian eruptions with ash emission followed the explosion, and new lava effused at the bottom of the summit crater. After that, vulcanian explosions produced ash fall and bombs at intervals.

We examined change in water-soluble F, Cl and SO₄ contents of volcanic ash in the sequence of the 2004 eruption of Asama volcano. The 2004 eruptive activity was divided into three phases according to the mode of the volcanic activity. The ash in Phase I issued by vulcanian explosions before the effusion of new lava was an aggregate of rock fragments altered under acidic conditions. The contents of water-soluble Na, K, Ca, Mg, Fe, Al, F, Cl, and SO₄ were noticeably high. This is mainly attributed to fluoride, chloride and sulfate alteration products formed by reaction of rock fragments within the summit crater with HF, HCl and SO₂ in volcanic gases before the 2004 eruption. Although molar ratio of Cl to SO₄ in the ash leachates was not equivalent to HCl/SO₂ of eruptive gases in this phase, increase in the Cl/SO₄ in the ash leachates in the late of this phase suggests that volcanic gases significantly became hot.

In Phase II, new lava effused at the crater bottom and the ash was extremely fresh. The contents of the water-soluble components of the ash in this phase were significantly less than those of the ash in Phase I. The Cl/SO₄ in the ash leachates was equivalent to the HCl/SO₂ ratio in the plume observed by FT-IR. This result indicates that water vapor in plume did not condense into droplets of water. Owing to reaction of the ash particles with volcanic gases at high temperature without condensation of water vapor, the contents of the water-soluble components of the ash were very low. While, the F/Cl values of the ash leachates were significantly higher than that of plume, which was due to selective fixation of HF on the ash particles.

In Phase III, the contents of the water-soluble components of the ash were clearly more than those of the ash in Phase II, which suggests that the lava effused in Phase II was gradually altered by volcanic gases. Although molar ratio of Cl to SO₄ in the ash leachates is probably not equivalent to that of the eruptive gases in this phase, the Cl/SO₄ in the ash leachates mirrored temperature of the hot region at the crater bottom.

Key words: volcanic ash, ash leachate, volatile components

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