Chemical composition of snow cover and vegetation damage caused by volcanic gas in Jigoku-dani, Mt. Tateyama

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Volcanic activity has increased in Jigoku-dani, Mt. Tateyama, since the Great Eastern Japan Earthquake in March 2011, and so has the amount of HCl and SO_2 contained in volcanic gas collected there. This makes necessary careful surveillance throughout the year, but the severe climate hinders it in winter. In this study we analyzed the chemical composition of snow in Jigoku-dani for two purposes; (1) to infer the volcanic activities during the winter months, and (2) to estimate the damage to plants by volcanic gas components.
The results of our analysis of the major chemical components and isotope ratio of the samples of snow collected at several points in the study area between 2013 and 2016, along with the elution experiment on alpine plants collected in 2016, are summarized as follows.
1) By (i) estimating the time of snowfall from the d-excess of snow cover, and (ii) comparing the volcanic gas component in snow with minute changes in the altitude of the mountain, it was possible to trace the past volcanic activities in winter.
2) The pH of the snow around the fumaroles during the years 2013-2015 ranged from 2.85 to 4.93. The closer to the fumaroles, the more acidic the snow was. Because nss-Cl- accounted for about 90% of $[H^+]$ in 2013 and 2014, it is inferred that nss-Cl^- from volcanic gas strongly contributes to the acidification of snow cover. In 2015, the contribution of nss-Cl^- decreased and its vertical distribution also changed. This is attributed to elution of ingredients due the melting of snow. nss-SO_4^{2-} measurements remained between 3.1 −5.0% over the three years, and little variation was observed across the layers of the snow.
3) Comparing the $[SO_4^{2-}]$ and $[Cl^-]$ on snow surface, the concentration of SO_4^{2-} was higher than that of Cl^- and it was speculated that Cl^- rapidly eluted with the melting of snow and SO_4^{2-} eluted gradually.
In conclusion, it is suggested that nss-Cl^- leads to strong acidification of the environment, including the snow cover.

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