Influence of volcanic activity on Hayakawa riverbed sand chemical composition in Hakone volcano caldera

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Introduction

There are 111 active volcanoes distributed in the Japanese islands. The definition of active volcano is a volcano that has erupted in approximately the last 10,000 years and/or a volcano with vigorous fumarolic activity at present (Report of Coordinating Committee for Prediction of Volcanic Eruption, No. 84). Among the volcanoes with above definitions, we have dormant volcanoes with no historical eruption and no present fumarolic activity. Even at such a volcano, eruption could happen in the future. In considering volcanic disaster prevention, it is important to predict how calm active volcanoes will act in future. The volcanic activity in future is highly likely to resemble past activities. Therefore, even in calm volcanoes where fumarolic activity is not observed, identifying the location of past fumarolic activity is useful in predicting volcanic activity. In active volcanoes, traces of the influence of the fumarolic activity that existed in the past may remain in the riverbed sand. Riverbed sand represents the elemental concentration of the crustal surface layer of the upstream area and has been used to prepare the geochemical map which is the concentration distribution diagram of elements. In this study, we examine how the riverbed sand of mainstream and tributary of Hayakawa River flowing in the Hakone volcano caldera is affected by the volcanic activity using multivariate analysis (principal component analysis).

Experiment and Operation method

We collected sand at eleven places of mainstream and tributary of Hayakawa River flowing in the Hakone volcano caldera. About 1 kg of riverbed sand was collected with a shovel, dried, and sieved to obtain granules (0.30 to 0.85 mm) and coarse grains (0.85 to 1.7 mm). Next, using a magnet, material having magnetism such as magnetite was removed from the sieved sample, and then ultrasonic cleaning was performed with pure water. This was pulverized in an agate mortar and dissolved using 0.15 mL of 6 M HClO4 solution and 0.30 mL of 25 M HF solution. The solution was further allowed to stand at 120 C for 6 hours and at 170 C for 6 hours, heated at 200 C until dried up, and cooled. To the dried up material 0.20 mL of 10 M HCl solution as added, heated again until dried up at 120 C, and cooled. Finally, the sample was dissolved with 5.00 mL of 0.5 M HNO3 solution, and 0.5 M HNO3 solution was added to until a total volume of 25 mL to prepare a sample stock solution. This stock solution was suitably diluted and analyzed by ICP-MS (Thermo Fisher Scientific, iCAP Q). Analysis results were processed by multivariate analysis (principal component analysis).

Results and Discussion

As a result of principal component analysis of the analysis values of sand at eleven places, the first principal component showed a strong positive correlation with Sc, V, Y and lanthanoid. In general, granite group tend to be enriched in those elements, so it seems that they reflect the influence of granite. In addition, the second principal component showed a positive correlation with Mg, Al, Ca, Ti, Mn, Fe, Sc and V, and negative correlation with Na and K. It seems to reflect the nature of the major element, so it seems to indicate the type of rock in the area around Hakone volcano caldera. Next, it was found that

there is a positive correlation with Sc and V in both the first and second principal components. Mainstream of Hayakawa river of sands coincides with the region dominated by volcanic ash in which Sc, V are contained with concentration higher than young upper crust in the Japanese islands (Togashi et al., 2000; Miyazaki, 2016), suggesting that the second principal components are affected by volcanic ash.

References

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