

PIXE analysis of the water of stream, hot spring and lake following the Mt.Hakone eruption on June, 2015

– temporal variation from June, 2015 to January, 2018 –

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Abstract

After the 2011 Off the Pacific Coast of Tohoku Earthquake, volcanic activity in Japan was observed to increase. On 30 June 2015, Japanese Meteorological Agency raised the volcanic alert to a Level 3 for Mt.Hakone, after a small eruption. For the purpose of grasping the volcanic activity degree in the Owakudani fumarolic area, we analyzed elements of three kinds of water of stream, hot spring and lake, by using PIXE method. It is thought that composition in stream water and hot spring water are reflecting the volcanic activity, because stream water is flowed directly from the Owakudani fumarolic area and hot spring water is made in a process of a mixing between volcanic hot gases and underground water in the nearby Owakudani fumarolic area. Water samples were collected approximately once a month from June 2015 to January 2018.

For one year after the eruption, the concentrations of magma-derived elements (S, Cl) and rock-derived elements (Al, Ca, Fe, K, Mg, Mn, and Na), except for Si, showed a clear decreasing trend in the stream water. These measurements suggest that magmatic activity and fumarolic activity reduced gradually over one year. In the hot spring water, the concentration of six elements, Ca, K, Mg, Na, S and Si showed the similar temporal variation to these of stream water. These results suggest that nine elements (S, Cl, Al, Ca, Fe, K, Mg, Mn and Na) in the stream water and six elements (Ca, K, Mg, Na, S, and Si) in the hot spring water are useful as the index of the magnitude of volcanic activities in Mt. Hakone.

After this year-long period, elemental concentrations stopped decreasing and instead showed broadly flat levels with sporadic increases and decreases. However, throughout the year immediately following the eruption, the number of volcanic earthquakes was consistently at zero or close to zero. These different indications of volcanic activity suggest that the elemental

concentrations in the stream water or in the hot spring water may be more sensitive indicators of small changes in subterranean behavior than of the number of volcanic earthquakes. And PIXE method was suitable for grasp of the volcanic activity degree, because PIXE is high sensitive and multi-element analysis at the same time.