

Oxygen and hydrogen isotope ratios of the crater spring waters and others in Owakudani fumarolic area, Hakone Japan.

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During the 2015 eruption of Hakone volcano, small craters and several fumaroles were newly formed in Owakudani fumarolic area. Through those vents, the thermal water and the volcanic vapor have been released. We have monitored the oxygen and hydrogen isotope ratios of these waters, artificial hot spring water and other surface waters.

All points of these waters on the δ -diagram forms a line crossing two points, one of which is the point of intersection of two lines namely the meteoric water line and the mixing line proposed by Matsuo et al. (1985). The other point is indicating the isotope ratios of the crater water. This result implies a mixing of the local meteoric water and the isotopically heavy water such as crater water controls the isotopic variation of the water in this area. However, no water sample indicates the direct participation of HTDS (high temperature deep steam after Matsuo *et al.* (1985)) to the mixing system. The inclination of the line was about 3.7, and after Horita and Wesolowski (1994), it corresponds to the ratio of isotopic fluctuations with boiling under 150°C. We thus consider that isotopic condensation by evaporation under such condition is taking place underground of the area.

Furthermore, we investigated the relationship between the isotope ratios and the major anion concentrations. Since a weak correlation between the isotope ratios and the sulphuric ion concentrations was found, volcanic gases containing hydrogen sulphide were supposed to act as a heat source of fumarole activity. On the other hand, no clear correlation was found between the isotope ratios and the chloride ion concentrations, and participation of the volcanic thermal water supplied from the deep part were thought to be limited both temporally and spatially. However, for waters in and around the craters, multiple processes, such as isotopic condensation by multistage evaporation, the mixing of the hydrogen sulfide of volcanic gas, and the incursion of volcanic thermal water, have to be considered to explain the isotope ratios or major anion concentrations of water samples.

Keywords: Hakone volcano, crater spring waters, oxygen and hydrogen isotope ratios