Determination on the stable isotopic compositions of H_2O in a volcanic plume

*Masanori Ito[1], Urumu Tsunogai[1], Koji U Takahashi[2], Fumiko Nakagawa[1]

1. Nagoya University, Graduate School of Environmental Studies, 2. Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology

The fumarolic H_2O occupied more than 80% of volatiles ejected from volcanic fumaroles (volcanic gases). The origin of fumarolic H_2O is either magma (magmatic water) or groundwater (meteoric water). Because of the significant differences in the isotopic ratios (δ D and δ^{18}O) of H_2O between magmatic water and meteoric water, we can differentiate the origins of fumarolic H_2O (magmatic water or meteoric water), if we can determine the isotopic ratios of fumarolic H_2O from those in volcanic plumes during a volcanic eruption. This is extremely useful for us to differentiate the mechanism of each volcanic eruption, magmatic eruption or phreatic eruption.
In this study, we determined the isotopic ratios of H_2O in a volcanic plume that had been ejected from accessible fumaroles to confirm whether the isotopic ratios (δ D and δ^{18}O) estimated from plume H_2O is consistent with those of fumarolic H_2O or not.
The samples were taken in Hakone volcano from 2014 to 2018. We collected around 20 volcanic plume samples into pre-evacuated glass bottle (ca. 1000 ml) during each sampling, while changing the distances from the fumarole. Besides, we also collected the fumarolic H_2O through condensation using a cold trap. The isotopic ratios (δ D and δ^{18}O) of plume H_2O showed strong linear correlation (R^2 = 0.9 or more) with the reciprocal of H_2O concentration. The isotopic ratios (δ D and δ^{18}O) estimated as the intercept of the linear correlation found in the plume H_2O was consistent with fumarolic H_2O. We concluded that we can estimate the stable isotopic ratios of fumarolic H_2O remotely using those in plume H_2O.
This study was supported by MEXT Scientific Research Program grants “Integrated Program for Next Generation Volcano Research and Human Resource Development”.

Keywords: Volcanic gases, Stable isotopic compositions, Cavity Ring-Down Sectroscopy

