Multi-GAS measurements at Mt.Tokachidake

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Introduction: The composition and flux of volcanic gases and those temporal changes are clues to understand degassing processes and their relevant structure below volcanoes.. The system so-called “Multi-GAS” device that consists of several gas sensors has been used to measure the chemical composition of volcanic gases on site (Shinohara, 2005). For the same purpose we started measuring volcanic gases at Mt. Tokachidake and Mt.Tarumae in 2014 using separate portable gas sensors of three kinds. We so far verified that even such a combination of off-the-shelf devices was able to provide reliable results, when applied to the plume with sufficient concentrations (Okamoto, 2015: JpGU).
At Mt.Tokachidake, localized ground inflation near 62-2 crater was detected since 2006 from GNSS by JMA and GSH. During May to August in 2015, further localized acceleration in ground deformation as well as the changes in thermal activity around the crater were found. For example, the fumarolic area called Furikozawa at the south of 62-2 crater extended eastward, whereas the bubbling in the hot ponds was seen at the bottom of 62-2 crater. We repeated our Multi-GAS measurements at Mt. Tokachidake in July and September in 2015 to monitor the temporal changes in gas chemistry associated with the recent volcanic activity.
Field operation: In this study, we used three separate gas sensors (SO_2, H_2S and CO_2). The detection range of each sensor was 0-100 ppm for SO_2, 0-100 ppm for H_2S, 0-9999 ppm for CO_2. The resolution was 1ppm for SO_2, 0.1ppm for H_2S, 1ppm for CO_2. The response time of the CO_2 sensor was approximately one minute, which was considerably longer than the H_2S, SO_2 sensors. For this reason, we walked slowly in the plumes flowing on the crater rims, and took one-minute moving average on the time series of H_2S and SO_2 in order to match them to the CO_2 sensor with the longest time constant. Afterwards, cross-sensitivity between H_2S and SO_2 sensors was calibrated and corrected. At Taisho-vent, due to the prevailing wind and topographic constraint, the plumes were flowing just on the rim. Therefore, we also profiled the gas concentrations to obtain the gas flux.
Results: We measured the plumes from Taisho-vent, 62-2 creator and Furikozawa fumarolic area in July and September in 2015. We obtained almost the same results between the two measurements. Molar ratios between compositions were estimated from the linear trends on the scatter plots as SO_2/H_2S~6, CO_2/H_2S~5 and CO_2/SO_2~1 at Taisho-vent, CO_2/SO_2~0.5 at 62-2 crater, and CO_2/SO_2~0.4 at Furikozawa fumarolic area. Unlike the result from Taisho-vent, H_2S concentrations at 62-2 crater and Furikozawa fumarolic area were close to the detection limit. The SO_2 emission rate was estimated as 6 to 7 t/d. These results were not significantly different from the measurement in 2014 and thus we considered that no essential change in degassing processes took place during this period. Meanwhile, total SO_2 flux (based on the DOAS method) from the crater area in 2015 was reported as 100 to 200 t/d by JMA, which was almost double amount of the flux in 2014. Accordingly, it is likely that most of the SO_2 flux in 2015 was the contribution from 62-2 crater and from the activation of Furikozawa fumaroles. Regarding the difference in gas component between Taisho-vent and others, we have not yet reached any consistent model that can explain all the results above, although we speculate some contribution of the shallow hydrothermal system beneath the crater area.

Keywords: Mt.Tokachidake, volcanic gas

