

Survey of volcanic gases in Ibusuki volcanoes using simple volcanic gas measurement method

*Yuuka Matsugasumi¹, *Ryuki Uemoto¹, *Kokoro Kurose¹, *Chiyono Kawamoto¹

1. Ikeda High School

Purpose Volcanic disaster prevention is an important issue for Kagoshima Prefecture, which has many volcanoes. Therefore, we began accumulating volcanic gas data from Ibusuki volcanoes, which is relatively inactive. Ultimately, we aim to capture precursory changes and predict eruptions.

Methods Since last year, measurements of fumarolic temperature and volcanic gas concentration have been carried out at three sites in Ibusuki volcanoes: "Yumine Gongen" fumarolic zone, "Sumedani" fumarolic zone and "Unagiike Sume hiroba" fumarolic zone.

Method of recording fumarolic temperatures In the past, measurements were taken with thermocouple thermometers only on survey days, but this time automatic measurements at 10-minute intervals were undertaken. As it is difficult to secure a power supply in fumarolic areas, a commercially available temperature recorder that operates on dry cell batteries is modified for fumarolic measurements.

Methods for investigating volcanic gases

We use commercial gas sensors. However, commercial sensors cannot directly measure volcanic gases, which are mainly composed of water vapour at high temperatures. Therefore, a method was adopted to measure the volcanic gases collected with a syringe by condensing them and diluting them with air.

A sealed polyethylene bag containing the gas sensor was used as a container for the dilution.

The measured components were CO₂, SO₂ and H₂S, based on the rule of thumb of Iwasaki. In addition, the presence of CO was confirmed with a detector tube.

The measurement procedure was as follows.

- (1) Gas concentration around the fumarole is measured with a commercial gas sensor to confirm safety.
- (2) Vacuum the sealed polyethylene bag (Ziploc) containing the sensor using a syringe and fill it with 1500 mL of diluted air.
- (3) Remotely collect 200 mL of volcanic gas from the fumarole, cool it with a damp cloth and condense the water vapour in the syringe.
- (4) Transfer the collected gas from the syringe to a sealed polyethylene bag, wait until the gas in the container is uniform and record the value displayed on the sensor.
- (5) Determine the actual value from the dilution rate of the diluted air in the bag.
- (6) Collect 100 mL of the gas in the container with a detector tube and measure the concentration.

The actual concentration of volcanic gases is determined by multiplying by the inverse of the dilution ratio. If the gas is contained in air, correct the dilution ratio.

Results and discussion The upper graph shows the change in air temperature every 10 minutes over a four-month period from 12 June to 29 October, measured with an automatic temperature recorder, with air temperature on the vertical axis and elapsed time on the horizontal axis. The graph below represents the AMeDAS data for temperature and precipitation in Ibusuki for comparison. During this period, the fumarolic temperature of Ibusuki volcanoes was close to 100°C, indicating that temperature and rainfall do not have a significant effect on the fumarolic temperature. However, when volcanic gas eruptions were low or rainfall was heavy, fumaroles were sometimes affected by the outside air, and a large temperature drop was observed when sediment or water entered the fumaroles.

Graphs of CO₂ and SO₂, gases from magma, and H₂S, gases from groundwater, as well as their composition ratios are presented. If the values of these composition ratios increase, volcanic activity is considered to be increasing.

From March to April, $\text{CO}_2/\text{H}_2\text{S}$ increased at Sumedani, and from July to August, $\text{SO}_2/\text{H}_2\text{S}$ increased at Yumine.

This increase is thought to be related to underground magma activity and changes in groundwater levels, so more data will be added in the future to investigate the relationship with earthquakes and other events. This year, we were also able to measure SO_2 concentrations, which could not be measured by gas sensors last year, using the method employed by the JMA and Sawada, where H_2S and SO_2 detector tubes are connected in series.

This was not the case in Smedani and unagiike, where high concentrations of CO were detected in the gas sensor measurements, but the gas detector tube measurements repeatedly showed 0 ppm, and we suspected a malfunction due to CH_4 or H_2 , but all attempts to measure these gas components with detector tubes were below the detection limit and the inhibiting gases could not be identified. It was not possible to identify the inhibiting gases.

Future plans

In the future, we would like to improve the gas sensor, investigate gases that react to the CO sensor, improve and devise methods for measuring volcanic gases, and accumulate basic data for future volcanic disaster prevention through long-term observations.

Keywords: volcanic gases, Ibusuki volcanoes

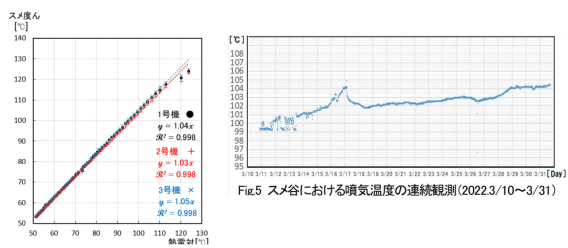


Fig.5 スメ谷における噴気温度の連続観測 (2022.3/10~3/31)

