Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SVC49-05 Room:102B Time:May 25 15:15-15:30

Volcanic plume measurements of Ontake volcano by unmanned aerial vehicle (UAV)

MORI, Toshiya[1*] ; HASHIMOTO, Takeshi[2] ; TERADA, Akihiko[3] ; SHINOHARA, Hiroshi[4] ; KAZAHAYA, Ryunosuke[4] ; YOSHIMOTO, Mitsuhiro[5] ; TANAKA, Ryo[2]

[1]Laboratory for Earthquake Chemistry, Graduate School of Science, the Univesity of Tokyo, [2]Graduate School of Science, Hokkaido University, [3]Volcanic Fluid Research Center, Tokyo Institute of Technology, [4]Geological Survey of Japan, AIST, [5]Mount Fuji Research Institute, Yamanashi Prefectural Government

On Sept. 27, 2014, a phreatic eruption occurred at Ontake volcano, central Japan, caused unprecedented disaster and took the lives of many tourists. The explosion plume rose up to nearly ten thousand meters and ash fall was observed as far as about 100 km east in Yamanashi Prefecture (JMA, Sept., 2014). The plume activity gradually decreased but the volcano still vigorously emits white plume as of Feb. 2015.

We made plume observation using a multicopter UAV on Nov. 20 and 21, 2014 to carry out following four kinds of measurements; sulfur dioxide flux, in-plume multiple gas concentrations, thermal images of the crater area and collection of fine particles inside the plume. In Ontake volcano measurements, the UAV was expected to fly 4000 m roundtrip distance at the altitude of 3000 m. Thus, the respective instruments were made compact and light to fit the payload of 1kg. The SO_2 flux measurements was carried out by traversing below the plume with a compact UV spectrometer operated by a single-board-computer. In the multiple gas concentration measurements, H_2S, SO_2, CO_2, H_2 sensors and a thermohygrometer (H_2O)were loaded to the UAV and flew inside the plume. In these in-plume flights, an adhesive film was used to collect fine particles inside the plume. An infrared thermography camera mounted on the UAV was used to image Jigokudani crater area to reveal the thermal condition. On Nov. 20, takeoff and landing of the UAV was located at Iimorikougen ropeway station about 3.5 km ENE due to NE plume direction. On Nov. 21, the UAV was operated from Tanohara park about 3 km SE from the crater area to approach the plume flowing in ESE direction.

Sulfur dioxide flux and SO_2/H_2S molar ratio obtained by the UAV plume measurements were 130-140 ton/day and about 0.09 for Nov. 20-21, 2014. No volcanic H_2, CO_2 and H_2O were clearly detected due to high mixing ratio of atmosphere. The thermal images of Jigokudani crater showed maximum temperature of 90.6 ℃ corresponding to the boiling point of the local altitude. Although some fine particles including crystalline minerals were found on the adhesive films, they were probably dusts from the ground.

Prior to the UAV measurements on Oct. 9, in-plume multiple gas concentration measurements were carried out using Multi-GAS analyzer onboard a helicopter and we obtained SO_2/H_2S molar ratio of about 0.3, indicating a significant decrease of the ratio by Nov. 20-21, 2014. Sulfur dioxide flux was over 1000 ton/day just after the eruption and was 400-500 ton/day (JMA, Oct. 2014) on Oct. 9 and decreased to 130-140 ton/day in two months after the onset of the eruption. In contrast, a total sulfur flux on Oct. 9 was about 1000 ton/day and was about 800 ton/day on Nov. 20-21 showing no significant change. The plume activity of 2014 Ontake volcano eruption is characterized by high total sulfur flux, however, low fumarolic temperature and low SO_2/H_2S ratio suggest that volcanic gas at Ontake volcano is not directly emitted from magma.

After 1979 Ontake volcano eruption, SO_2/H_2S molar ratio showed significant decrease from 5 soon after the eruption to 0.1 an year after the eruption (Ossaka et al., 1983). The decrease of SO_2/H_2S molar ratio after the eruption is the common characteristic of the two eruptions in 1979 and 2014. Detailed comparison of the two eruptions would be important to understand the future of ongoing Ontake volcano's activity.

Keywords: Ontake volcano, volcanic gas, UAV