Visualization of sulfur dioxide in the volcanic plume

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Sulfur dioxide flux from volcanoes reflects conditions at depth of the volcanoes such as degree of magma degassing. Thus, SO2 flux monitoring is crucial for understanding the status of volcanic activities. Until recent, since 1970's, Correlation Spectrometer (COSPEC) has been used for SO2 flux measurements at volcanoes. Since the beginning of this century, a miniature size ultraviolet spectrometer based on DOAS (Differential Optical Absorption Spectroscopy) technique was utilized for volcanic SO2 flux measurements. This miniature SO2 monitoring system is not only small and light but also low cost compared to the COSPEC, thus, the instrument is used for monitoring at many volcanoes in the world. Taking advantage of the low price, new observation methods are developed using the multiple instruments.

There are two methods, traverse and panning, for measuring SO2 flux at volcanoes. The traverse method measures zenith column amount of SO2 and scans the plume by moving under the plume. In contrast, the panning method waves the field of view of the telescope back and forth to scan the plume from a fixed observation point. Time intervals for measuring SO2 flux using these two methods is constrained by the time required for scanning the volcanic plume. Thus, time interval for the flux is from a few minutes to a few tens of minutes for the traverse method and from a minute to a few minutes for the panning method. With such a long time intervals, it is insufficient to discuss the short time variations of flux which may be related to volcanic tremors and earthquakes. Second-scale time interval data is desirable from the view point of dealing with short time variations. If SO2 in the plume can be visualized and be observed as images, we will be able to detect second-scale flux variations and observe detailed plume behaviours. Plume speed can be obtained simultaneously by visualizing the flow of the plume. Visualization of the plume flow will also contribute to volcanic gas hazard prevention.

In this paper, we are going to introduce a newly developed system to visualize the behaviours of volcanic SO2 plume.SO2 has absorption band at around 300nm in ultraviolet range, the COSPEC and the miniature UV spectrometer system use this absorption band for SO2 quantification. The visualizing instrument also uses this SO2 absorption band. The system uses near UV CCD camera, UV band path filters for visualization of the plume. The preliminary observation using the system was carried out on Nov. 18, 2005 at Sakurajima volcano. The weather was clear and the plume was almost transparent on the day. We successfully visualized and obtained clear images of SO2 plume using the instruments. We also quantified SO2 amount by comparing the degree of absorption with those of SO2 standard cells. In our presentation, we are going to show SO2 images captured by the developed system. We also discuss the problems, applications and prospects of the newly developed system.