

## 論文の内容の要旨

論文題目 : Searching for a linkage between volcanic gas flux and geophysical phenomena using sulfur dioxide visualization technique

(二酸化硫黄可視化装置を用いた火山ガス放出量と地球物理学的観測量の因果関係の探求)

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Remote sensing of volcanic gas emissions provides an important insight into subsurface magma dynamics. The degassing process plays a crucial role on the eruptive activity. To address this issue, investigations from manifold perspectives including not only volcanic gas studies but also geophysical observations are needed. However comparisons between volcanic gas data and other geophysical phenomena in previous studies were limited to long-term changes and indirect relations mainly because of low time resolution of the conventional volcanic SO<sub>2</sub> emission rates observation.

Recent developed Ultra Violet (UV) camera observation systems opened the possibility to investigate the linkages between volcanic gas and geophysical data streams by the innovative high temporal volcanic SO<sub>2</sub> measurement. Since the instruments can visualize SO<sub>2</sub> column amount distribution in the volcanic plume, these techniques also enable the detection of SO<sub>2</sub> fluxes from multiple vents. The main aim of this study is investigation of the relationship among volcanic gas emission and other geophysical streams by means of the volcanic gas observation using the UV camera observation system and sophisticated analyses of these brand new gas visualization data.

Surveillance of the UV camera observation was conducted at Sakurajima volcano, Japan, which has two craters: Showa crater and Minamidake crater. The different degassing activities of the two craters were examined by the distinction of SO<sub>2</sub> fluxes for individual vent by dint of the SO<sub>2</sub> visualization technique. The separation method for SO<sub>2</sub> emission from distinct vent allows comparing gas emission fluctuation and other geophysical data stream of Showa crater, which has been brisk lately. The gas emission fluctuations as a precursor of Vulcanian explosions at the crater were observed. The gas flux decreased before the explosions. This fact is consistent with the sealing process suggested by previous studies.

Multiple volcanic observations conducted at Mt. Asama, Japan, provide evidence of a link between single very-long-period (VLP) seismic pulses and volcanic gas emissions. Volcanic gas emission regarding a VLP pulse was given by analyses of high temporal SO<sub>2</sub> flux data obtained by the UV camera observation system. Comparison between gas amount and VLP seismic moment showed a linear relationship. The observational results have a good agreement with theoretical seismology. The linkage induced enables estimation of gas amount release related to VLP pulses by means of seismic signals without any volcanic gas observations. This methodology was applied to examine long-term degassing activity of Mt. Asama. Comprehensive treatment of the data unveiled the geometry change at depth before and after the eruption on 2 February 2009 at Mt. Asama. Although the previous seismic study suggested that the VLP source is explained by a combination of a tensile crack and a cylinder, the model at depth within the volcano was improved from a point of view of volcanic gas.

As the UV camera observation systems require more favourable observation condition than conventional methodologies, simulation techniques regarding operation of the instruments are needed to collect the data efficiently. Laboratory experiments were conducted to achieve a calibration free observation system. UV spectral data measured by the UV spectrometer were fed back to UV footages taken by the UV camera system. A combination of laboratory experiments and UV spectrum analyses sheds a light on development of an automated and steady UV camera observation system.