Development of volcanic gas composition measurement techniques

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Many exapmples of volcanic gas composition variation have been reported as precursory phenomena of volcanic eruptions. Time-resolution of the geochemical data, however, are commonly very poor compared with geophysical data, such as seismicity and deformation and detailed comparison of geochemical and geophysical data is often difficult, in particular for short-term variation. Volcanic gas composition measurements were also limited by asseccibility to the source vent and the data during eruptive periods were quite difficult to obtain. Application of the Multi-GAS [1,2] is improving these difficulties of the geochmical monitoring. We review recent developments of volcanic gas composition measurement techniques by the use of Multi-GAS.

High frequency (such as daily) and long-term measurements became possible with an automatic Multi-GAS monitoring system. One of the most significant achievement is detection of gas composition variations shortly before an eruption, such as observed at Stromboli [3]. In order for a precise measurement, a Multi-GAS needs to be installed near a gas vent where plume concentration is high. However, it is often difficult to access the vent and we can install only on a flank where a plume can reach sporadically. In order to measure the plume at distance, we developped a Multi-GAS which start measurement only when a concentrated plume reaches to the Multi-GAS system.

Another approach to plume is an air-borne measurement. We developped methods using various air-craft, including unmanned fixed wing [4], unmanned helicopter, drone [5] and Cessna. UAVs are more flexible to approach to areas with high risk and were applied to the measurement during eruptive periods when access to the volcanoes were strictly limited. UAVs, however, often have a limited pay load and we need to reduce Multi-GAS system to fit the pay load requirement. An advantage of a Cessna flight is an unlimited pay load and space with which we can collect plume air samples, such as for isotope measurements ([6]).

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