Quantitative understanding of volcanic activities by a combinational use of geophysical and geochemical data - a case study of magmatophreatic eruptions at Kuchierabu volcano, SW Japan

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Generally, magma ascent to a shallow part of a volcanic edifice induces swarms and crustal deformations. Newly-developed cracks and fractures would promote the magma ascent and release of volcanic gases from the magma. The released gases develop a hydrothermal system beneath the edifice, by mixing with the shallow groundwater. When the gas and heat fluxes increase and/or the ascending magma body encounters the groundwater system, phreatic / magmatophreatic eruptions would be induced because of unstable pressure-temperature conditions of the system.
Geophysical and geochemical data (i.e., seismicity, total magnetic intensity, resistivity, InSAR, GPS, and volcanic gas composition) are powerful tools to understand such the various volcanic activities. Also, numerical simulation programs such as HYDROTHERM and STAR can quantitatively evaluate the pressure-temperature conditions beneath the volcano associated with the hydrothermal activity. Therefore, it is expected that the combinational use of the above data and simulations could quantitatively and precisely evaluate the volcanic activity, which might also improve the prediction of the volcanic activity.
Based on the above concept, a working group was established by the authors, to enable the combinational use of the data for the quantitative evaluation of the volcanic activity. In this study, our group will introduce a case study of the magmatophreatic eruption at Kuchierabu volcano, SW Japan, occurred in August 2014 and May 2015. Numerical simulation of the hydrothermal system using the HYDROTHERM software (Hayba and Ingebritsen, 1994) estimates the temporal evolution of the pressure-temperature conditions after the increased flux of volcanic gase and heat and/or the encounter of the magma body. By combining with the previous studies and observed data [i.e., resistivity structure and demagnetized sources (Kanda et al., 2010), volcanic gas data, GPS, and InSAR], our group will try to quantitatively understand the mechanism of the magmatophreatic eruption

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