Movement of magma at depths within mt. asama, japan, revealed by ground deformation and volcanic gas studies

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Detection of magma movements under a volcano is very crucial to understand the volcanism and the magma plumbing system. For this regard, ground deformation studies provide insights of magma injection and changes of inner pressure within a volcano. On one hand, volcanic gas studies give us information of the amount of degassed magma and volumetric decrease of the magma body as a result of gas release to the surface. A combination of volcanic gas and ground deformation studies can open a new path for understanding volcanic mechanisms which cannot be achieved when each method is applied alone. However, there are only a few reports which describe correlations between them. In this study, we show the correlation of volcanic gas emission and GPS data to reveal the magma movement at Mt. Asama, Japan.

At Mt. Asama, there were very minor eruptions in August 2008. Volcanic SO_2 flux observed by a UV spectrometer increased from a few hundred to several thousand ton per day at the same period (Ohwada et al. in prep.). Ground deformation associated with the eruptive events preceded these surface phenomena by 3-4 months. The inflation at a deep dike modelled by Aoki et al. (2005) started in March 2008 and continued until April 2009. The inflation at a shallower depth within the conduit followed in April 2008. This pressurization at the shallow part ceased with the abrupt increase of volcanic SO_2 emission in August 2008.

To compare GPS and volcanic gas data sophisticatedly, a degassing mechanism is needed to be assumed. The long-term constancy of volcanic gas composition and huge SO_2 emission at Mt. Asama suggest magma convection in the conduit. When assuming this convection model, a speed of convection is one candidate to control volcanic gas emission. As mentioned before, the pressurization of the deep dike started 4 months before the eruptions and the increase of SO_2 emission in August 2008. This pressure increase at the depth should have driven the convection of magma in the conduit more efficiently so that the increase of SO_2 emission and the small eruptions followed. The observed deformation is likely to be due to the shear stress applied to the conduit wall at shallow depths. The synchronism between the deformation cessation and the increase of SO_2 emission in August 2008 implies the depressurization of the conduit by reason of the huge gas release.