

Budget of shallow magma plumbing system at Asama Volcano, Japan, revealed by ground deformation and volcanic gas studies

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Characterization of magma transport under a volcano is crucial to understand the magma plumbing system of the volcano. Complementing geochemical and geodetic studies, we evaluated the magma transport at Asama Volcano, Japan. Multiple cycles of the intensive volcanic gas discharge and ground deformation (inflation and deflation) were observed at Asama Volcano, Japan, from 2000 to 2011. Magma budget of the shallow magma plumbing system was estimated on the basis of the volcanic gas emission rates and ground deformation data. Recent inflations observed in 2004 and 2008 were modeled as a dike intrusion to 2–3km west of Asama Volcano. Previous studies proposed that magma ascends from a mid-crustal magma reservoir to the dike and reaches the surface via a sinuous conduit which connects the dike to the summit. The intensive volcanic sulfur dioxide discharge of up to 4600 t/d at the volcano was modeled by magma convective degassing through this magma pathway. The volcano deflates as shrinkage of the magma in a reservoir by volcanic gas discharge. We estimated the volume change of the dike modeled based on the GPS observations, the volume decrease of the magma by the volcanic gas discharge, and the amount of degassed magma produced to calculate the magma budget. The results show that the volume decrease of the magma by the volcanic gas discharge was larger than the volume change of the dike during the inflation periods. This indicates that a significant volume of magma at least more than 2 times larger than the volume change of the dike was supplied from the mid-crustal magma reservoir to the dike. The volume decrease of the dike was comparable with the volume decrease of the magma by the volcanic gas discharge during the deflation periods. These results strongly suggest that an amount of magma moved through a magma reservoir is possible to be significantly larger than volume change of the magma reservoir estimated by the geodetic observations.