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HR: 1515h
AN: **V33F-07**
TI: Coupled effects of vertical and lateral gas escapes on conduit flow dynamics and chemistry of volcanic gas during lava dome eruptions
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AB: During lava dome eruptions, gas phase can escape from magma in two different ways: vertical gas escape through the magma to the vent and lateral gas escape through the conduit wall. The competition between these gas escapes and vesiculation of magma leads to complex features of conduit flow such as a variety of magma porosity distribution inside the conduit. In this study we systematically investigated how the vertical and lateral gas escapes control the conduit flow dynamics and the chemistry of volcanic gas during lava dome eruptions on the basis of a 1-dimensional steady conduit flow model. When the vertical and lateral gas escapes are taken into account, the feature of the conduit flow is classified into two types (Type A and Type B) depending on whether the permeability of vertical gas escape and/or that of lateral gas escape are larger than critical values or not. When both the vertical permeability and lateral permeability are smaller than the critical values, the flow pattern is characterized by a high magma porosity and a high overpressure at shallower levels of the conduit (Type A). The flow of this type has a characteristic that average porosity of magma in the conduit increases as mass flow rate increases. This feature results in a negative correlation between the mass flow rate and the chamber pressure, which cause complex dynamics such as abrupt initiation and/or termination of the eruptions as well as cyclic change of magma discharge rate (Koyaguchi and Kozono, 2010 AGU Fall Meeting). On the other hand, when the vertical permeability and/or lateral permeability are larger than the critical values, the flow pattern is characterized by a low magma porosity and a low overpressure at shallower levels of the conduit (Type B). In this type, the mass flow rate has a positive correlation with the chamber pressure. The transition from Type B to Type A induced by the decrease in the vertical or lateral permeability may cause drastic changes in the pattern of the conduit flow. The results of extensive parameter study suggest that the critical condition of the transition between Type A and Type B flow type sensitively depends on the efficiency of lateral gas escape. Our model indicates that the efficiency of lateral gas escape can be constrained by chemical features of volcanic gas to some extent. In order to evaluate the efficiency of lateral gas escape, we introduced a non-dimensional number E that is defined as the ratio of lateral gas escape to vertical gas escape. This parameter controls the partitioning of volatile components between gas and melt, and hence, the compositional variation of gas phase and volatile component during magma ascent; the type of the compositional variation gradually changes from the batch fractionation to Rayleigh fractionation as E increases from 0 to 1. This indicates that we can predict the condition for the transition of the flow pattern during lava dome eruptions by estimating E from field data of the chemistry of volcanic gas.
DE: [8410] VOLCANOLOGY / Geochemical modeling
DE: [8414] VOLCANOLOGY / Eruption mechanisms and flow emplacement
DE: [8425] VOLCANOLOGY / Effusive volcanism
DE: [8434] VOLCANOLOGY / Magma migration and fragmentation
SC: Volcanology, Geochemistry, and Petrology (V)
MN: 2010 Fall Meeting

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