



Evaluation of lava flow rate from other flow parameters

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The effusion rate of lava from a volcanic vent is the main quantity controlling the length of the ensuing lava flow. The ability to evaluate the lava flow rate is therefore of paramount importance in order to estimate the hazard connected with the flow. Since the lava flow rate can not be directly measured, as one could do for a liquid flowing in a pipe, it must be calculated from other measurable flow parameters. Due to the difficulty of measuring physical quantities in active lava flows, it is advisable to reduce the number of these parameters as much as possible. For any flow, the obvious way to calculate the (volume) flow rate is multiplying the average flow velocity times the cross-sectional area. However the average flow velocity can not be measured. It can be calculated, but depends on several quantities such as the density and the viscosity of lava, the acceleration of gravity, the ground slope, the flow thickness and width, the yield stress (if the Bingham rheology is assumed). In the present paper we provide formulas giving the flow rate for 2D and 3D Newtonian and Binghamian flows. In order to keep the difference between the actual lava flow rate and the model estimation within 10%, the 3D model must be used if the ratio between the width and the thickness of the lava flow does not exceed the value 10. The Binghamian model must to be used if the ratio between the plug thickness and the thickness of the lava flow exceeds the value 0.15.