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Topographic confinement of a lava flow: a possible key to estimating rheological properties and emplacement conditions

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The emplacement of a lava flow is strongly controlled by the preexisting topography. Although this may appear to be obvious, the effect of the topographic confinement on the flow morphology depends on both flow properties and flow emplacement style. As such, a topographically confined morphology may provide an opportunity to estimate flow parameters such as rheological properties (e.g., viscosity, yield strength) and emplacement conditions (e.g., eruption rate). We perform numerical simulations for a "simple" aa flow from the Okmok 1997 eruption and find that flow rheology determines whether or not new flow-unit formation (branching) occurs from the main flow at a topographic divide or the flow remains confined by local topography. Interestingly, branch length may increase for higher viscosity flows, when considering the effect of topographic control. Also, even one order of magnitude difference in the rheological properties allows lava flows to move in completely different paths. This strongly suggests that flow bifurcation due to topographic control provides insight to the local rheological properties of a simple aa lava flow. The effect of the topographic confinement is not limited to simple flows. Although the emplacement of a compound pahoehoe flow seems chaotic, the advancing motion at a scale such as a lobe itself often resembles a continuum flow. For example, the overall width of the lobe, which is composed of numerous different sizes of toes, is often relatively constant along a slope. This suggests that there is a self-confinement mechanism for pahoehoe flow emplacement. In this talk, we also present a simple two-component model to explain the overall width of a Hawaiian (Mauna Ulu) pahoehoe flow at a given topographic condition and discuss how the topographic confinement affects the emplacement of a

pahoehoe lava flow.