Challenges and recent advancements in modeling lava flow breakouts

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The growth and subsequent failure of solidified lava fronts and margins can lead to sudden changes in lava flow propagation rate and direction. These lava flow breakouts can result in lasting changes to the lava flow path and can be the dominant propagation mechanism in cooling-dominated flows, especially including those with evolved compositions and under water, ice, or dense atmospheres. The breakout process depends sensitively on the thermal history of the flow margins, the global pressure and flow field, and also on the detailed local topology in regions of failure, where even small-scale differences in crustal thickness or strain rate history can have strong localizing feedbacks; all of which makes simulation, especially for real-time hazard assessment, challenging. In this talk, I will review the underlying processes of lava flow breakouts, summarize existing laboratory and field constraints, and highlight existing models that address the problem from statistical and physics-driven approached which give us directions for improving modeling efforts