

Investigating Cooling Rates of a Controlled Lava Flow using Infrared Imaging and Two Heat Diffusion Models

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Observation and investigation of surface cooling rates of active lava flows can help constrain thermal parameters necessary for creating of more precise lava flow models. To understand how the lava cools, temperature data was collected using an infrared video camera. We explored two models of the release of heat from lava stream; one based on heat conduction, another based on crust thickness and radiation. The lava flow, part of the Syracuse University Lava Project (<http://lavaproject.syr.edu>), was made by pouring molten basalt at 1300 Celsius from a furnace into a narrow trench of sand. Hanging roughly 2 m over the trench, the infrared camera, records the lava's surface temperature for the duration of the flow. We determine the average surface temperature of the lava flow at a fixed location downstream as the mean of the lateral cross section of each frame of the IR imagery. From the recorded IR frames, we calculate the mean cross-channel temperature for each downstream distance. We then examine how this mean temperature evolves over time, and plot cooling curves for selected down-stream positions. We then compared the observed cooling behavior to that predicted by two cooling models: a conductive cooling model and a radiative cooling model with constant crust thickness. Both models are solutions to the one-dimensional heat equation. To create the best fit for the conductive model, we constrained thermal diffusivity and to create the best fit for the radiative model, we constrained crust thickness. From the comparison of our data to the models we can conclude that the lava flow's cooling is primarily driven by radiation.