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Video monitoring analysis of the dynamics at fissure eruptions

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At basaltic eruption often lava fountains occur. The fountains mainly develop at erupting fissures, underlain by a magma-filled dike transporting the magma horizontally and vertically. Understanding of the dynamics of the deep dike and fracture mechanisms are mainly based on geophysical data as well as observations from seismic or geodetic networks. At the surface, however, new methods are needed to allow detailed interpretation on the eruption velocities, interactions between vents and complexities in the magma paths.

With video cameras we collected imaging data from different erupting fissures. We find that lava fountaining is often correlated at distinct vents. From the frames of the videos we calculated the height and velocities of fountains as a function of time. Lava fountains often show a pulsating regime, that may change over time. Comparing the fountain height as a function of time of different vents by an time-dependent cross-correlation, we find a time lag between the pulses at adjacent vents. From this we derive an apparent velocity of temporal separation between vents, associated with the fountaining activity based on the calculated time lag and the vent distances. Although the correlation system can change episodically and sporadically, both the frequency of the fountains and eruption and the rest time between single fountains remain remarkably similar for adjacent lava fountains imply a controlling process in the magma feeder system itself.

We present and compare our method for the Kamoamoa eruption 2011 (Hawaii) and the Holuhraun eruption 2014/2015 (Iceland). Both sites show a significant time shift between the single pulses of adjacent vents. We compare our velocities determined by this time shift to the assumed magma flow velocity in the dike as determined by independent models. Therefore we conjecture that the time shift of venting activity may allow to estimate the dynamics of magma and fluid migration at depth, as well as to identify the direction of magma intrusion. This demonstrates that video monitoring is a useful tool to analyze the behavior of fountains at fissure eruption and may allow us interpreting the dynamic system within the dike.