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Graben-structure complexities at Mt. Laki, Iceland, investiged by camera drones and modeling

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Fissure eruptions are often associated with formations of structural lineaments and a tectonic graben. Asymmetrical surface structures, formed by the fissure eruption of Laki volcano (Iceland) in 1783/84, are investigated for genesis and development in relation to loading and geometrical effects. The Laki craters, which form a NE-SW oriented row of about 140 vents over a distance of 25 km, are accompanied by asymmetrical ruptures close to the fissure. The graben forming ruptures show local complexities that are especially large at Mt. Laki. The dependence of the ruptures' form and orientation on dyke-geometry, loading effects and topography shall be studied here by using camera drones as central working method and stress modeling. Therefore, over 5000 photos, taken in several overflights with two camera drones over the top of Mt. Laki and on the northeastern/southwestern sides, were collected and converted into 3D-models using Structure from Motion (SfM). Afterwards, offset and orientation of the graben structures have been measured by profiles along and across the ruptures. The calculated trends of offset and distance to the vents provide a geometric constrain on the orientation and geometry of the underlying dyke. We compared this geometry of surface fractures to simulated fractures. In order to do so, the finite element method (FEM) was used to model stress and strain parameters close to a simulated dyke. Depth and dip of the dyke were systematically changed. The results of FEM are then compared to the photo results and provide an overall picture of the formation of the surface structures' local complexities at Mt. Laki and at other sites of the fissure eruption.