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Fault and fissure development in the recent fissure swarm of Vogar (SW Iceland) revealed from detailed aerial mapping

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The Reykjanes Fissure Swarm is the westernmost fissure swarm of the five fissure swarms that develop in the Reykjanes Peninsula. These swarms link the off shore Reykjanes Ridge to the on land Western Volcanic Zone and to the South Iceland Seismic Zone. The Reykjanes Fissure Swarm is a 35 km-long and 5 to 8 km-wide zone of recent faulting, fissuring and volcanism, directly connected southward to the offshore Reykjanes Ridge. Its northern half, called Vogar fissure swarm (VFS), develops in postglacial basaltic pahoehoe lavas older than AD 871 and younger than 0.8 My. The VFS provides an excellent illustration of the recent fracture pattern, allowing its geometrical analysis over a wide range of investigation scales, from minor fissures to large faulted-tilted blocks. Using aerial photos at a scale of $\sim$1/25000 and photogrammetric techniques, we mapped the fractures over an area 30 km2. The cumulated length of mapped fractures is $\sim$45 km. Fissures with negligible vertical offset have been distinguished from faults with significant vertical offset. All fractures together are organized in deformation zone where series of partly overlapping and close fracture of different type extend along a general strike. The individual faults range from 34 m to 1288 m in length (mean length 229 m). The individual fissures have a comparable minimum length (23 m) but maximum and average length significantly shorter (545m and 139m, respectively)
Automatic across strike profiles reveal a general graben structure with an average width of $\sim$5 km. Inside the graben the west facing faults dominate in frequency. Different types of profile across the main faults are observed (short width graben, roll-over ...). Along strike offset profiles for five main faults have also been achieved. They correspond to the offset measured at a distance of 20 m or 40 m from the main step. The offset variations reveal that the main faults are composed of individual liked segments with a length of $\sim$500m in average. Along each sub-fault, the offset is symmetrically distributed with a downward "U shape" profile and reach a maximum of $\sim$10m. All studied faults do not have the same degree of linkage between their sub-parts. These differences correspond to an evolution from distinct fractures to a unique main fault. During a first step each segment increase it maximum offset to $\sim$10 m. Then the offset gaps between segments are filled during a linkage stage. Surprisingly the maximum displacement observed along the main composite fault do not increase during this step as $\sim$10m represents a limitation for the fault offset.