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## Structural analysis of the Theistareykir Fissure Swarm (NE Iceland) using field survey integrated with UAV-based - Structure from Motion techniques

Noemi Corti<sup>1</sup> and Alessandro Tibaldi<sup>1,2</sup>

<sup>1</sup>Department of Earth and Environmental Science, University of Milan-Bicocca, Milan, Italy

<sup>2</sup>CRUST- Interuniversity Center for 3D Seismotectonics with Territorial Applications, Italy

Due to its position at the boundary between American and European plates, Iceland represents an ideal natural laboratory to study active rifting processes, where rifting mechanisms are complicated by the superimposition of tectonic and magmatic stresses. In order to contribute to the study of such processes, we focused our attention on the southern sector of the Theistareykir Fissure Swarm (ThFS), an active volcanic rift belonging to the Northern Volcanic Zone of Iceland, affected by both volcanic and seismic hazard.

We studied an area which is about 22 km<sup>2</sup>-large, situated 12 km south of the intersection of the ThFS with the Husavik Flatey Fault (HFF), a dextral strike-slip lineament belonging to the Tjornes Fracture Zone (TFZ). The area is characterized by the presence of normal faults and a dense swarm of extension fractures, affecting prevalently post-glacial, Holocene lavas, dated 8-10 and 11-12 ka. Only in the western sector of the area a Late Quaternary interglacial lava crops out, while the northeastern sector is covered by a Weichselian subglacial hyaloclastite. The southern sector of the area has been investigated with classical field survey, whereas in the northern part a 3.87 km<sup>2</sup>-large area has been reconstructed using the Structure from Motion (SfM) techniques, combined with an Unmanned Aerial Vehicle (UAV), obtaining orthomosaics, DSMs and 3D models with a centimetric resolution through 4189 UAV photos, collected in 7 different missions during summer 2018.

In the whole area, we recognized and mapped a total of 624 structures (comprising 583 extension fractures and 41 normal faults), and we took various measurements at 626 structural stations along extension fractures, and 132 along normal faults. Regarding extension fractures, we collected the strike and, in 441 cases where it was possible, the opening direction and the amount of opening; along normal faults we measured the strike, dip and vertical offset.

Our approach allowed to calculate stretch values across the rift comprised between 1.002 and 1.013, and an average opening direction value of 104.4°N, normal to the average extension fracture strike measured at the structural stations (14°N), suggesting a pure extensional opening in the studied area. Actually, in 281 cases out of our 441 stations along extension fractures we noticed a lateral component > 5°. Furthermore, 49% of data is not consistent with tectonics,

neither with regard to the extensional fracture strike, nor with regard to opening directions. This suggests that stresses linked to regional tectonics are not the only cause of deformation, which could have been affected by different processes like dyke intrusion, deglaciation, and inflation/deflation of the Theistareykir volcano magma chamber.