



Structural Analysis of the Thingvellir Fissure Swarm, Southwest Iceland

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The Holocene Thingvellir Fissure Swarm is part of the 60 km long Hengill Fissure Swarm in the West Volcanic Zone of Iceland and dissects a 9000 year old basaltic lava north of Lake Thingvallavatn. The swarm contains some of the largest postglacial fractures in the rift zone of Iceland. The centre of the Hengill Fissure Swarm is a 0.8 Ma year old central volcano of the same name. Its top is dissected by NE-SW-trending normal faults, some of which can be followed to the Thingvellir Fissure Swarm. The Thingvellir Swarm itself is dominated by nearly vertical tension fractures (mode I) and gaping normal faults arranged en echelon and subparallel to each other with an average strike of N29°E. The length of the fractures ranges from 360 m to 7.7 km; the throw varies from 0.5 m to 40 m. On the boundary fault Almagnagja the maximum opening is 68 m.

During tectonic studies in the Pleistocene Hengill area along a 7 km long E-W profile, more than 60 faults, including 35 large normal faults, were measured. The normal faults strike on average NE-SW and are subvertical at the surface. The maximum throw measured in the field is 160 m on a large normal fault that dissects the northwest slope of the Hengill. More than 85% of all measured normal faults, however, have throws smaller than 25 m. The largest normal faults occur at and near the western margin of the Hengill Fissure Swarm. For example, Saemundsson (1967) measured a throw of more than 240 m on a normal fault southwest of Lake Thingvallavatn and a throw of some 400 m on a fault in the area of Botnssalur, northwest of the lake. Similarly, our measurements on aerial photographs indicate 210 m throw on the normal fault Jorukleif, southwest of Lake Thingvallavatn (this area comprises some of the oldest rocks in the Hengill area).

A 30 km long profile extending from the 3 Ma Pliocene rocks of the fjord Hvalfjörður to the Holocene lava flows of the Thingvellir Swarm was measured by Forslund and Gudmundsson (1991). The profile is dissected by 156 normal faults with a mean strike of N37°E. The average throw is 10 m; the maximum measured throw being 150 m. Faults dip on average 75.2°. These Quaternary faults are thus steeper than generally in the Tertiary areas of Iceland where the average fault dip is around 69°.

The present structural data indicate that the stress field controlling the Holocene development in the Thingvellir Fissure Swarm has been maintained for at least the last 3 Ma. The dominating northeast trend of all major extensional structural elements in the area indicates that the maximum tensile stress trends N110°-130°E. This trend is roughly similar to that of the present geodetic vector.

Forslund, T. and Gudmundsson, A., 1991. Crustal spreading due to dikes and faults in southwest Iceland. *Journal Structural Geology*, 13, 443-457.

Saemundsson, K., 1967. Vulkanismus und Tektonik des Hengill Gebietes in Südwest Island. *Acta Naturalia Islandica*, Vol. II, pp. 105 (in German with English summary).