

The Stress Pattern of Iceland

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In the framework of the IMAGE project we compiled the first comprehensive stress map of Iceland from different stress indicators and new analysis of data from 51 Icelandic geothermal boreholes. In total we interpreted ~34 km of acoustic image logs for stress indicators, i.e. borehole breakouts and drilling induced tensile fractures. Furthermore we revised the existing 38 data records for Iceland in the World Stress Map and conducted an extensive literature research to compile all available focal mechanism solutions and geological stress indicators. The new stress compilation consists of 444 data records for the orientation of the maximum horizontal stress (S_{Hmax}) in and around Iceland with 307 data records of A-D qualities according to the World Stress Map ranking scheme (Fig. 1). Most of the A-D quality data records are from geological fault inversions (38%) and focal mechanism solutions (27%). Borehole related indicators (breakouts, drilling induced fractures, hydro-fractures) have a share of 14% while data from the alignments of volcanic vents, fissures and craters contribute with 12%. The inversion of several focal mechanism solutions make up 9% of the dataset. The mean orientation of S_{Hmax} is $16^\circ \pm 39^\circ$ for all A-D quality data. A closer look at subregions reveals four different provinces with fairly consistent S_{Hmax} orientation. They are in the Capital area and Southern Lowlands (mean $S_{Hmax} = 38^\circ \pm 29^\circ$), the eastern Highlands and Eastfjords (mean $S_{Hmax} = 9^\circ \pm 25^\circ$), the Tjörnes Fracture Zone and Akureyri (mean $S_{Hmax} = 152^\circ \pm 21^\circ$), and the Westfjords (mean $S_{Hmax} = 137^\circ \pm 17^\circ$). This distribution of S_{Hmax} orientations is in agreement with the prevailing structural geology. At the spreading ridges Reykjanes and Kolbeinsey in the South and North respectively an orientation of S_{Hmax} parallel to the plate boundary is observed. The same is observed in the Northern and Eastern Volcanic Zones and it is also indicated by the few indicators associated with the Western Volcanic Zone. In the transform South Iceland Seismic Zone and Tjörnes Fracture Zone which produce Iceland's largest earthquakes, S_{Hmax} is at an angle of approximately 20° to 60° to the transform faults which define the plate boundary. A rotation from ridge parallel to the general intraplate ridge normal S_{Hmax} is expected at some distance from the plate boundary. Such a rotation is observed in the Westfjords, NW-Iceland.

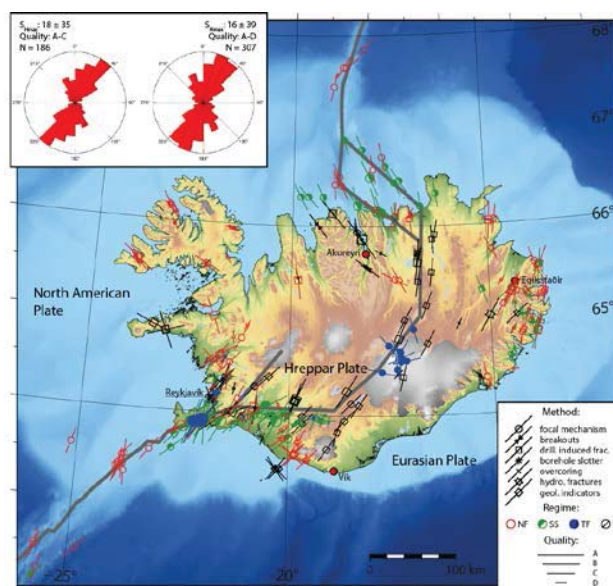


Fig. 2: Stress indicator of quality A-D in Iceland. The lines represent the orientation of S_{Hmax} . Major tectonic features are shown.