The New Iceland Stress Map 2015

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Abstract

Iceland with its unique position on top of a mantle plume and the Mid-Atlantic Ridge provides the country with large geothermal resources. For the safe and sustainable exploitation of the geothermal energy detailed information on the contemporary crustal stress field is of key importance (Reiter & Heidbach, 2014). However, in the current release of the World Stress Map (WSM) (Heidbach et al., 2010) only 38 stress indicators for the orientation of maximum horizontal stress S_{Hmax} are listed in and around Iceland. This poor coverage is not sufficient to allow a general statement on the stress state, let alone for a specific exploration site. Especially in a structurally diverse and geologically young environment like Iceland the stress field tends to be heterogeneous. Hence we currently update the Stress Map for Iceland and present the first preliminary results.

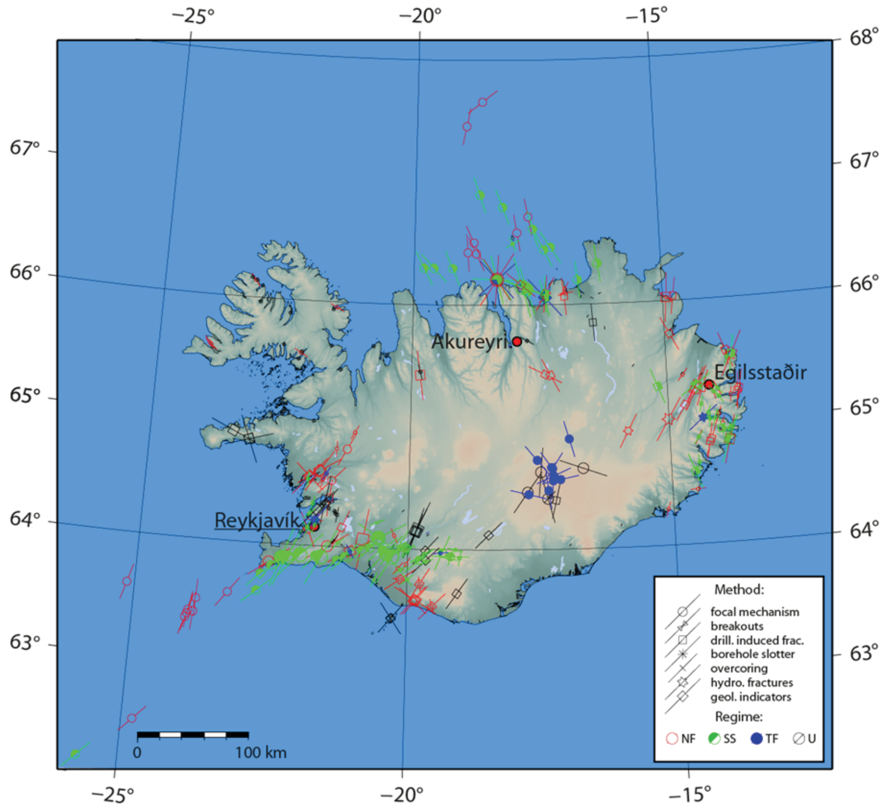

Figure 1. The new stress map of Iceland (02/2015). The orientation of SHmax is indicated by the lines. The length of the lines refers to the quality of the data according to the WSM quality ranking (Heidbach et al., 2010). The type of data as well as the stress regime is displayed according to the legend

An area of interest which includes Iceland and the neighbouring off-shore areas is defined (N: 62°-68°, W: 11°-26°). The update of the Icelandic Stress Map is achieved in several steps. First, the data in the present Icelandic stress map were revisited and the latest WSM quality ranking scheme from Heidbach et al. (2010) was applied. In a second step, literature databases were scanned for stress indicators within the area of interest. This produced a 10-fold increase in data to 361 data records for the S_{Hmax} orientation. Each data record was rated according to the current WSM quality ranking scheme. A large amount of geological indicators and focal mechanisms were added to the database. In contrast to that only few borehole data are available. The preliminary updated map shows a good agreement of average S_{HMax} orientation of about 45° in the Southwest (Reykjanes and

Southern Lowlands/South Iceland Seismic Zone [SISZ]) and in the West of Iceland (**Figure 1**). In the North the S_{hmax} orientation also shows a quite robust average of about 160° (**Figure 1**). However, in the northern parts of the Vatnajökull glacier, an initially arbitrary arrangement of S_{Hmax} is observed (**Figure 2**). Especially the focal mechanism solutions of earthquakes related to the ongoing eruption of Barðabunga show orientation fluctuations over very short distances. This is most likely due to frequent volcanic activities in that area.

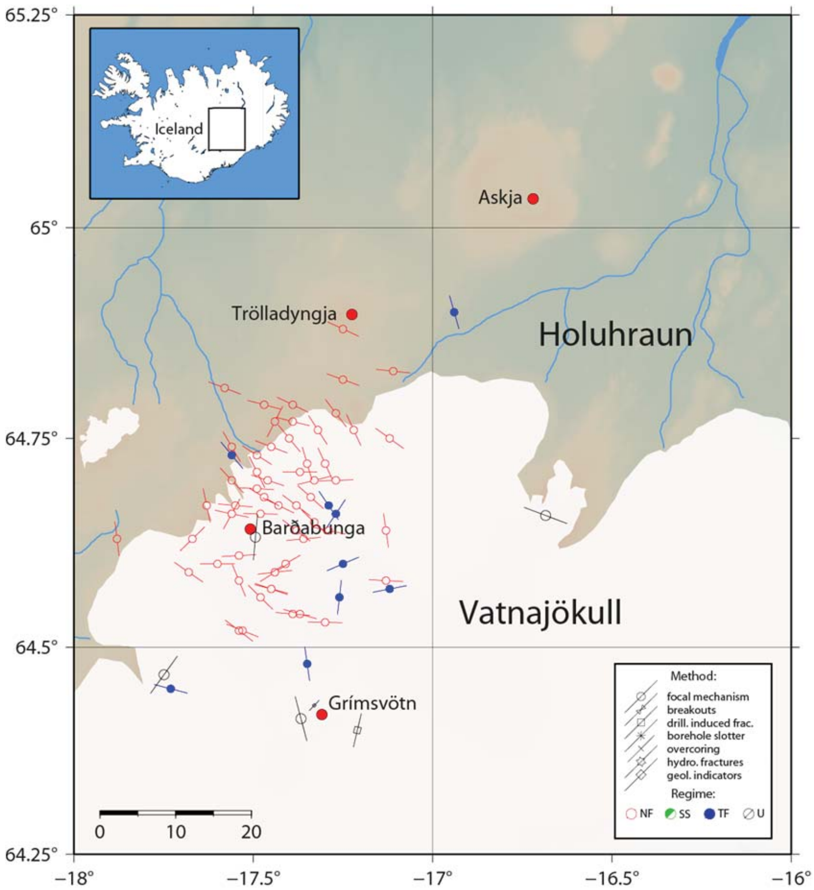

Figure 2. SHmax orientation derived from earthquakes mainly related to the 2014/2015 activities in Barðabunga which is related to the rifting event in Holuhraun.

Geological indicators and focal mechanisms, which are both available in abundance, are challenging stress indicators in the given geologic and structural conditions. This is because of the young and very dynamic crust in Iceland and the position on a rift in a complex tectonic environment, respectively. Therefore, the next step is to revisit all the available data in the map and critically review them for their significance. In addition, Formation Micro Image (FMI) logs of some 50 geothermal boreholes are available and will be analysed in the next few month. They will be interpreted for borehole breakouts and/or drilling induced tensile fractures. This data from another indicator in comparison to the data which is already gathered will provide valuable information concerning the significance of the stress map.

Acknowledgements

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References

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