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Mapping and dynamics analysis of fractures using relative earthquake locations in Hengill, SW-Iceland

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Hengill volcano is located on a triple junction in Southwest Iceland connecting two extending and one conservative plate boundary: the Reykjanes Volcanic Zone (the on-land continuation of the Mid-ocean ridge), the Western Volcanic Zone and the South Iceland Seimic Zone in which earthquakes of magnitudes reaching lower seven occur. The Hengill area was subjected to a significant volcano-tectonic event between 1993 and 1999, when a small volcanic intrusion induced over 90 thousand earthquakes in the region. The intrusion caused a 5-year-long period of crustal uplift, centered near the NE corner of the triple junction and induced intense seismicity in uplift-source region. With time the seismicity propagated south through the South Iceland Seimic Zone, where two events of M>5 were generated in 1998.

Two geothermal power plants are operated exploiting the geothermal reservoir underneath the Hengill volcano, producing together 420 MW electricity and 430 MW of warm water. Hence, understanding the dynamics and processes active in the area is of great scientific and economical interest.

Parts of the earthquakes have been used to map faults and to analyse their dynamics. The remaining events, mainly in the uplift-source region will be the focus of a new project within the research project “Interaction of geothermal, tectonic, and magmatic processes in the Hengill area, SW-Iceland”, supported by The Iceland Centre of Research (Rannís). One of the project aims is to complete the mapping of the fractures that were active during the nineties and to analyze their movements during the episode. Therefore, we use cross-correlation methods to refine the pick quality and then apply relative earthquake locations to map the strike, dip and location of faults. By calculating focal mechanisms for suitable earthquakes, selected based on the number and spatial distribution of identified phases, we learn about the stress field and movements on the fractures. We plan to compare the results with fractures active today with the goal to estimate the time scales that are relevant in this highly active and laterally variable area. The mapping of fractures provides valuable information on permeability at depth which can help to position future well bores.