

# Development of seismic activity at the Hellisheidi Geothermal Power Plant since the autumn of 2011

On one hand, the figure shows the magnitude of seismic activity and, on the other hand, the accumulated number of seismic tremors during the period. The seismic data are obtained from the national seismometer network of the Icelandic Meteorological Office. Intense induced seismicity followed the commissioning of the Husmuli reinjection field in September 2011, and it peaked in mid-October when two magnitude  $M_L$  4 events occurred. At the end of 2011/beginning of 2012, seismic activity gradually decreased and, by the summer of 2012, had almost faded out. Activity increased again in the autumn of 2012 but was nothing like what it was when it started. The reason for this was that production at the district heating utility started again after a summer break. This cooled the disposal water somewhat and its flow subsequently increased, which in turn resulted in a rise in the capacity of the reinjection wells and in seismic activity.

In early 2014 there was some seismic activity related to the testing and launching of the SulFix project. This activity was within acceptable limits and had mostly faded by the summer. In mid-September 2016, seismic activity started in the Husmuli area by the Hellisheidi Geothermal Power Plant. Experience from operating the reinjection utility at the Hellisheidi Geothermal Power Plant has shown that seismic activity can be caused by sudden changes in operations. An examination of the operations of the reinjection utility in relation to the seismic activity in September revealed that no changes had been made in the lead-up to the series of tremors. In addition to injection-related tremors, increased activity has been detected in Hverahlid, where production began in 2016. The largest earthquake in Hverahlid measured at magnitude  $M_L$  3.1 in February 2018. Increased seismicity has not been detected in relation to injections east of Grauhnukar or at Nesjavellir, where reinjection into the geothermal reservoir commenced in late 2018.

