Induced Seismic Activity during Drilling of Injection wells at the Hellisheiði Power Plant, SW Iceland

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Topics

- Background seismicity
- Seismicity during drilling in the area
- Drilling of the re-injection hole HN-17
Seismic activity in the Hengill area

- 1993-1998 was a period of intense seismic activity in Hengill-Hellisheiði region
- During that time considerable seismic activity was in Húsmúlí.
- This period ended with two earthquakes of magnitudes 5.2 and 5.4 in 1998.
- Similar seismic activity was around 1910 and 1950.
Data from the Icelandic Meteorological Office

Earthquakes in Husmuli 1991 to 2015
Earthquakes in Husmuli 2002 to 2011
and drilling periods of HN and HE wells

Data from the Icelandic Meteorological Office
Earthquakes in Husmuli 2002 to 2011 and drilling periods of HN and HE wells

Data from the Icelandic Meteorological Office
The seismic network
Earthquakes during drilling and testing of well HN-17

Number of earthquakes/hr
Cumulative number of earthquakes

Cumulative number of earthquakes

Number of earthquakes/hr

0 10 20 30 40 50 60 70 80 90 100

1321 m
Bottom feeders?

1700 m
Well tests and stimulation

12/02 19/02 26/02 05/03

1000 800 600 400 200 0

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000

1321 m
Bottom feeders?

1700 m
Well tests and stimulation

12/02 19/02 26/02 05/03
Location of earthquakes February 11 and 21

Feb. 11 2011

Feb. 21 2011
Injection rate and number of earthquakes/day with M>0.2 in Sept. and Oct. 2011. The earthquake swarm starts when the injection rate is higher than it had previously been. The largest earthquakes occur when the injection rate is variable.
- Seismicity occurs during drilling of most injection wells in Húsmúli and some of the production wells
- Temperature of drilling fluid $< 20^\circ C$
- Reservoir temperature $\sim 200^\circ C$
- Overpressure $\sim 2$ Mpa
- Triggered events
- Earthquakes $\sim 20$ years premature
- Work in progress (e.g. 5-10 times more earthquakes locatable)