# GEOTHERMAL SEISMIC NOISE AT ÖLKELDUHÁLS

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## Abstract

Seismic noise is often observed around and associated with geothermal fields, e.g. in North America (e.g Oppenheimer and Iyer, 1980) and Iceland (Brandsdóttir *et al.*, 1994). The noise is found within a narrow frequency band centered close to 5 Hz. A possible mechanism for this harmonic tremor is hydrothermal boiling in groundwater flow channels (Leet, 1988).

Ten portable seismographs from the Loki instrument pool were deployed along a profile across Ölkelduháls geothermal area (near Hengill, SW Iceland) in summer 2008 in order to characterize harmonic tremor associated with the field. This was done by monitoring the distance decay of seismic noise away from the field. The instruments are Lennartz 3c, 5 s sensors and Rektek 130 recorders. They were first deployed along a line to the NE from Ölkelduháls with a spacing of about 300 m (Figure 1). Data were collected continuously at 100 Hz for two days. They were then moved to the SW of the geothermal field and deployed with a spacing of about 150 m, again for two days.

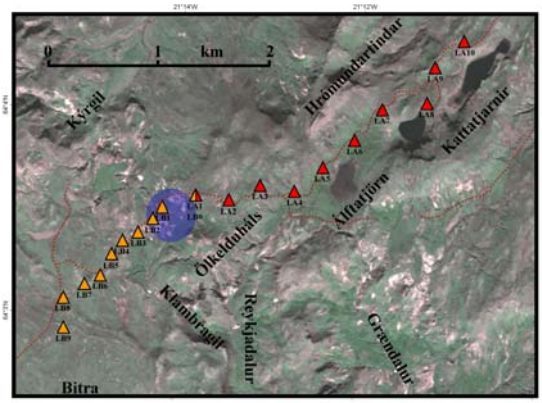


*Figure 1. Layout of the experiment. 10 instruments were used, first deployed at 300 m spacing to the NE of the geothermal field (blue), then at 150 m spacing to the SW.*

Amplitude spectra were computed for one-hour intervals in order to monitor temporal changes that could be associated with cultural or weather induced noise. The component of the spectra which was stable in time and clearly decayed away from the geothermal field was associated with the field.

The amplitude spectra are extremely stable in time in the frequency range between 4 and 6 Hz. The shape of the spectra in this range is reasonably consistent from one site to the next and their amplitude decays away from the geothermal field at Ölkelduháls (Figure 2). The decay of the spectra with distance away from Ölkelduháls clearly associates the noise with the geothermal field.

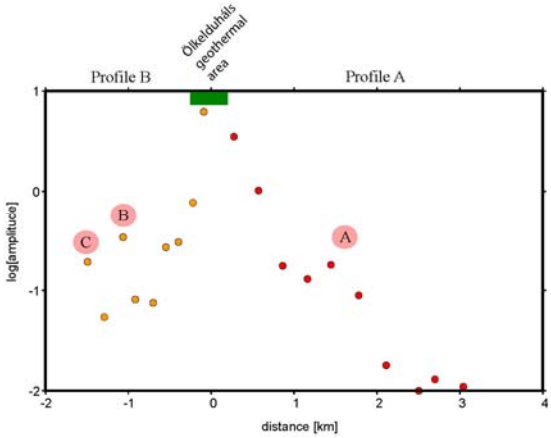


*Figure 2. Spectral amplitude in the range 4-6 Hz as a function of distance away from the geothermal field at Ölkelduháls.*

Irregularities in the amplitude decay with distance can be explained in part with other geothermal activity in the area, particularly to the NE. A local peak in the amplitude at 1.5 km (A, Fig.2) is about 500 m away from geothermal activity on the NW slopes of Hrómundartindar. Geothermal activity is also found just west of the SW end of the profile.

Array studies of geothermal noise at Norris Geysers, USA, indicate that the noise there is composed of surface waves with a shallow source (< 100 m) (Oppenheimer and Iyer, 1980). If this holds in general it will be difficult to use geothermal seismic noise as an exploration tool. However, we are able to detect the geothermal noise over many decades in amplitude with a cheap measurement. Weak signals from depth may therefore be detectable.

Assuming a surface wave origin of the geothermal noise the inferred elastic quality factor for the top 50 m of the crust is Q = 10.

## References

Brandsdóttir, Franzson, Einarsson, Árnason, and Kristmannsdóttir, 1994, Seismic monitoring during an injection experiment in the Svartsengi geothermal field, Iceland. *Jökull* **51**, 43-52.

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