



Long-term decay and possible reactivation of induced seismicity at the Basel EGS site

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In December 2006, an extensive fluid injection was carried out below the city of Basel, Switzerland, to stimulate a reservoir for an Enhanced Geothermal System (EGS). After six days of gradual increase of flow rate (and thus seismicity), a strongly felt ML3.4 earthquake led to the immediate termination of the project. The well was opened subsequently and seismicity declined rapidly.

The Basel EGS project might be an unsuccessful attempt in terms of energy supply, but a chance to advance the physical understanding of EGSs. The well-monitored and well-studied induced sequence allowed many new insights in terms of reservoir creation. A special observation in the nine years of monitoring is the revive of seismic activity six years after prolonged seismic decay. This renewed activity increase might relate to a gradual pressure increase due to the ultimate shut-in (closure) of the borehole about one year before. Until now, a detailed analysis of the long-term behaviour remained unexplored since a consistent catalogue did not exist.

In the current study, we took advantage of the high waveform similarity within a seismic sequence and applied a multi-trace template-matching (i.e. cross-correlation) procedure to detect seismic events about one order of magnitude below the detection threshold. We detected about 100,000 events within the six-day long stimulation alone—previously, only 13,000 microearthquakes were detected. We only scanned the recordings of the deepest borehole station (2.7km). This station is very close to the 5km-deep reservoir and has the highest signal-to-noise ratio among all (borehole-)stations.

Our newly obtained catalogue spans over more than nine years and features a uniform (and low) detection threshold and a uniform magnitude determination. The improved resolution of the long-term behaviour and the later seismicity increase will help to understand involved mechanisms better. More induced or natural sequences can be investigated with our procedure.