



Seismicity induced by fluid injection for Deep Heat Mining in Basel, Switzerland.

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This talk gives an overview on the Deep Heat Mining Project in Basel, Switzerland, and discusses the injection-induced seismicity recorded by the Swiss Seismological Service since the start of the main stimulation in Dec. 2006.

To stimulate the reservoir for a proposed "hot dry rock" geothermal project in the city of Basel, approximately 11500 m³ of water were injected between December 2nd and 8th, 2006, at high pressures into a 5 km deep well. A six-sensor borehole array, installed at depths between 300 and 2700 meters around the well to monitor the induced seismicity, recorded more than 10500 events during the injection phase. Events with magnitudes as low as $ML=0.7$ were also recorded by regional networks in Switzerland, Germany and France, as well as by up to 30 strong-motion stations installed in the epicentral area. Due to excessive seismic activity, that included an $ML=2.7$ event, injection had already been stopped when a few hours later an $ML\ 3.4$ event jolted the city of Basel. A large amount of (non-structural) damage, corresponding to an intensity of V (EMS98), has been claimed by home owners. After bleed-off, about one third of the injected water volume flowed back out of the well. Although seismic activity declined rapidly thereafter, three additional $ML>3$ events occurred over the following two months. From a statistical analysis it is expected that it may take on the order of a decade for the activity to decrease to the regional background level scaled to the size of the source region. The hypocenters of the located events (about 3500 to date) are restricted to a NW-SE oriented lens-shaped cloud, about 1 km in diameter and 200 m wide, with a single offsetting branch to the ESE. The orientation of the cloud and the

focal mechanisms determined so far match the stress field derived from observations of borehole breakouts and natural seismicity.

Due to the premature abortion of the stimulation process, the size of the stimulated volume is insufficient for a commercially viable exploitation of geothermal energy. At present the project is on hold, pending a comprehensive assessment of the seismic risk associated with a continuation.