



The 2008 earthquakes in the Bavarian Molasse Basin - possible relation to deep geothermics?

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We discuss several microearthquakes of magnitude up to $M_I=2.3$ that occurred in the Bavarian Molasse Basin (ByM), south of Munich, Germany, in February and July 2008. The strongest event was felt by local residents. The Bavarian Earthquake catalog, which dates back to the year 1000, does list a small number of isolated earthquakes in the western part of the ByM as well as a cluster of mining induced earthquakes (Peißenberg 1962-1970, $I_0(\text{MSK})=5.5$). The eastern part of the ByM, including the wider surrounding of Munich, was so far considered aseismic.

Due to the spatio-temporal clustering of the microearthquakes in February and July 2008 the University of Munich (LMU) and the Swiss Seismological Service installed a temporal network of seismological stations in the south of Munich to investigate the newly arising seismicity. First analysis of the recorded data indicate shallow source depths ($\sim 5\text{km}$) for the July events. This result is supported by the fact that one of these very small earthquakes was felt by local residents. The earthquakes hypocenters are located closely to a number of deep geothermal wells of 3-4.5km depth being either in production or running productivity tests in late 2007 and early 2008. Therefore, the 2008 seismicity might represent a case of induced seismicity related to the injection or withdrawal of water from the hydrothermal aquifer.

Due to the lack of high quality recordings of a denser seismic monitoring network in the source area it is not possible to resolve details of the processes behind the 2008 seismicity. Therefore, a definite answer to the question if the earthquakes are related to the deep geothermal projects or not can not be given at present. However, a number of recent well-studied cases have proved that earthquakes can also happen in depths much shallower than 5km, and that small changes of the hydrological conditions at depth are sufficient to trigger seismicity. Therefore, a detailed understanding of the causative processes behind the 2008 seismicity in the ByM is of paramount importance to hazard assessment and mitigation associated with similar geothermal projects underway elsewhere.

A close cooperation of operators and developers of geothermal projects with earthquake science has proved to be very beneficial in the development of the Hot-Dry-Rock technique and is also highly desirable in developing strategies for the safe geothermal use of deep hydrothermal aquifers.