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Microseismicity induced by a long-term fluid injection experiment at the KTB, Germany

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Data from the seismological monitoring of a massive fluid injection experiment at the KTB site (southern Germany) are presented. This long-term injection test has been carried out in the 4km KTB pilot hole from May 2004 to April 2005. Unlike previous experiments at the KTB, the target zone of the recent study is a known fault system in the crystalline crust (the 'SE2 reflector'). In order to observe the seismicity induced by the injection activities, we installed a real-time seismic monitoring system including a borehole sensor at 4km depth in the KTB main hole. By January 2005, some sixty induced microseismic events were detected by both the borehole seismometer and the near-surface instruments. Precise absolute event locations were calculated involving a grid-search algorithm in a local 3-D velocity model and cross-correlation time measurements. They allow to seismically image the hydraulically forced fault system. The hypocentres are located preferentially in a narrow, NW-SE striking band northeast of the injection point and in a maximum distance of 800m from the pilot hole. The spatio-temporal characteristics are discussed in the context of the hydraulic data and in terms of local stress relaxation and redistribution.