Monitoring hydrofrac-induced seismicity by surface arrays - the DHM-Project Basel case study

P. Blascheck, M. Häge, and M. Joswig

Institut für Geophysik, Universität Stuttgart, Germany, patrick.blascheck@geophys.uni-stuttgart.de

The method "nanoseismic monitoring" was applied during the hydraulic stimulation at the Deep-Heat-Mining-Project (DHM-Project) Basel. Two small arrays in a distance of 2.1 km and 4.8 km to the borehole recorded continuously for two days. During this time more than 2500 seismic events were detected. The method of the surface monitoring of induced seismicity was compared to the reference which the hydrofrac monitoring presented. The latter was conducted by a network of borehole seismometers by Geothermal Explorers Limited. Array processing provides a outlier resistant, graphical jack-knifing localization method which resulted in a average deviation towards the reference of 850 m. Additionally, by applying the relative localization master-event method, the NNW-SSE strike direction of the reference was confirmed.

It was shown that, in order to successfully estimate the magnitude of completeness as well as the b-value at the event rate and detection sensibility present, 3 h segments of data are sufficient. This is supported by two segment out of over 13 h of evaluated data. These segments were chosen so that they represent a time during the high seismic noise during normal working hours in daytime as well as the minimum anthropogenic noise at night. The low signal-to-noise ratio was compensated by the application of a sonogram event detection as well as a coincidence analysis within each array. Sonograms allow by autoadaptive, non-linear filtering to enhance signals whose amplitudes are just above noise level.

For these events the magnitude was determined by the master-event method, allowing to compute the magnitude of completeness by the entire-magnitude-range method provided by the ZMAP toolbox. Additionally, the b-values were determined and compared to the reference values.

An introduction to the method of "nanoseismic monitoring" will be given as well as the comparison to reference data in the Basel case study.