



## Mining induced seismicity in the Ruhr coal mining district, Germany

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In 2012 four hard coal mines (at about 1000 m depth) were operating in Germany, three of them are in the Ruhr coal mining district. The mining method used (longwall mining in combination with caving) causes induced earthquakes due to the stress redistribution in the surrounding rock. Seismic events of magnitude 1.2 and larger are generally perceived by the population and thus trigger a wide interest. The Ruhr-University of Bochum routinely monitors the seismicity and its temporal evolution and energy release since the 1980s. The current seismological network consists of 14 stations (broad-band and short-period seismometers) in the Ruhr area. Six stations are located at the Ruhr-University Bochum at distances of approximately 20-40 km to the active coal fields. The remaining 8 stations are located in the vicinity of the mines (app. 1 to 5 km from the active mining). The magnitude of completeness is 0.9 throughout the entire Ruhr coal mining district with a local magnitude of completeness of 0.7 depending on the network configuration. In general, the identified earthquakes have a horizontal location uncertainty of 3 km.

The routine detection and location of the seismicity is done by classical methods, e. g. based on first arrivals, and advanced methods like array techniques or cross-correlation of waveforms of master events with recorded seismograms from selected stations. Additionally selected event clusters are studied in more detail by reprocessing sub-datasets with methods like cluster analysis or consistent phase-picking. Reassessing this unique dataset of 30 years continuous recordings with newly developed methods and modern data processing techniques can provide new insights of the nature of mining induced seismicity.

This methods may also be usable in the field of geothermal energy, unconventional hydrocarbon reservoirs or underground storage of carbon dioxide which also deals with the detection and handling of large amounts of small magnitude earthquakes.