Geophysical Research Abstracts
Vol. 13, EGU2011-635, 2011
EGU General Assembly 2011

Moment Tensor Inversion of Coal Mining Induced Seismicity

Ali Tolga Sen (1), Simone Cesca (1), Monika Bischoff (2), Torsten Dahm (1), and Thomas Meier (3)

(1) Institute of Geophysics, University of Hamburg, Germany (ali-tolga.sen@zmaw.de), (2) Institute of Geology, Mineralogy and Geophysics, Ruhr University Bochum, Germany, (3) Institute of Geophysics, Christian-Albrechts-University Kiel, Germany

Coal mining in the Ruhr region, Western Germany, has been monitored continuously over the last 28 years by the Ruhr University Bochum. About 1000 seismic events with local magnitudes ML between 0.7 and 3.3 have been located every year. In 2006 a dense temporary network (HAMNET) was deployed to monitor the active longwall mining below the densely populated area in Hamm. The HAMNET network includes 9 short period and 6 broad-band stations. From July 2006 to July 2007 more than 7000 events with magnitudes ranging from -1.7 to 2.0 were located with this dense network configuration. Out of this dataset, about 900 events have magnitudes equal or larger than 0.0. Source depths are constrained in a narrow band, centered at about 1km depth. Epicentral locations and depths mostly correspond to the panel of active longwall mining. However, different clusters at further distances up to 500m have also been reported. The spatial and time distribution of induced seismicity show a high correlation with the mining activity. We perform a full moment tensor inversion for the largest recorded events, using a full waveform inversion technique. We first generated Green functions databases for different 1D layered models. The Kiwi inversion tools, which were developed and successfully applied in recent years to perform moment tensor inversion at regional and teleseismic distances, have been adapted here to carry out the inversion at a local scale (the maximal source-receiver distance is 3km). The inversion is carried out at different steps. First, a frequency domain moment tensor inversion is performed, fitting amplitude spectra of the full waveforms at frequencies between 0.1 and 5Hz. Then, a time domain inversion is used to solve the polarity ambiguity and to determine the best centroid location. As a result we obtain information about the centroid location, source depth, scalar moment and best double couple (DC) focal mechanism. A full moment tensor is also carried out, to evaluate DC, compensated linear vector dipole (CLVD) and isotropic source components. Results are compared with existing focal mechanism solutions, based on first motion polarities, polarization angles of S-waves and interpreted in terms of possible geomechanical modeling associated to the mining exploitation. We investigate the possibility to derive finite source model parameters, including the discrimination of the rupture plane and the estimation of the rupture size, for the largest events in the dataset.
This work has been funded by the German BMBF "Geotechnologien" project MINE (BMBF03G0737A) and by the German Research Foundation (DFG) within the Collaborative Research Centre 526. Instruments were provided by the Geophysical Instrumental Pool, Potsdam (GIPP).