Geophysical Research Abstracts
Vol. 13, EGU2011-482-2, 2011
EGU General Assembly 2011

Optimized detection and location of microearthquakes using a single vertical array in a deep borehole

Francesco Grigoli, Simone Cesca, and Torsten Dahm
Institute of Geophysics, University of Hamburg, Germany (francesco.grigoli@zmaw.de)

Microearthquake and microcrack detection and location are important challenges in reservoir monitoring and characterization. Detection tools are important to improve catalogue completeness, while high resolution location of microearthquakes allows to estimate the distribution and the orientation of the faults and pore pressure changes inside the reservoir. Examples are microseismicity tests performed by fluid injection at reservoir level. One month of continuous data have been recorded using a single vertical array of 70 m with six three-component geophones deployed at the end of deep borehole at about 2 km of depth. We developed our methods focusing on this dataset, related to a gas field located in Northern Europe. At first we have implemented a software module for the detection of seismic events. We have adopted a recursive STA/LTA algorithm of the total energy trace to pick the first P-phase arrival and we used the cumulative envelope function to set the ending time of the event. In this way we avoid to pick later phases and obtain a rough estimation of the duration magnitude of the seismic event. The use of only one vertical array cannot resolve the source azimuth if only arrival times data are used. This particular geometry of the network requires the development of an “ad hoc” location technique. Therefore we include polarization analysis to solve the ambiguity of the azimuth and we use Full waveform inversion to improve the resolution of the location. Since polarization is very sensitive to noise and the array sensors are very close each other, we align all traces and stack them. For solving the location problem we will combine grid search full waveform modeling with phase picking and polarization approach. To test the reliability of the method we applied our location technique to synthetic and real data, comparing the results obtained with our method with those obtained using other techniques.
This work has been funded by the German BMBF "Geotechnologien" project MINE (BMBF03G0737A)