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Time-lapse seismic tomography using the data of microseismic monitoring network and analysis of mine-induced events, seismic tomography results and technological data in Pyhäsalmi mine, Finland

Jouni Nevalainen (1) and Elena Kozlovskaya (2)

(1) Sodankylä Geophysical Observatory, University of Oulu, Oulu, Finland (jouni.nevalainen@oulu.fi), (2) Oulu Mining School, University of Oulu, Oulu, Finland (elena.kozlovskaya@oulu.fi)

We present results of a seismic travel-time tomography applied to microseismic data from the Pyhäsalmi mine, Finland. The data about microseismic events in the mine is recorded since 2002 when the passive microseismic monitoring network was installed in the mine. Since that over 130000 microseismic events have been observed.
The first target of our study was to test can the passive microseismic monitoring data be used with travel-time tomography. In this data set the source-receiver geometry is based on non-even distribution of natural and mine-induced events inside and in the vicinity of the mine and hence, is a non-ideal one for the travel-time tomography. The tomographic inversion procedure was tested with the synthetic data and real source-receiver geometry from Pyhäsalmi mine and with the real travel-time data of the first arrivals of P-waves from the microseismic events. The results showed that seismic tomography is capable to reveal differences in seismic velocities in the mine area corresponding to different rock types. For example, the velocity contrast between the ore body and surrounding rock is detectable. The velocity model recovered agrees well with the known geological structures in the mine area.
The second target of the study was to apply the travel-time tomography to microseismic monitoring data recorded during different time periods in order to track temporal changes in seismic velocities within the mining area as the excavation proceeds. The result shows that such a time-lapse travel-time tomography can recover such changes. In order to obtain good ray coverage and good resolution, the time interval for a single tomography round need to be selected taking into account the number of events and their spatial distribution.
The third target was to compare and analyze mine-induced event locations, seismic tomography results and mining technological data (for example, mine excavation plans) in order to understand the influence of mining technology to mining-induced seismicity.

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