PhD thesis title:

Means of implementation of short period seismic hazard assessment in Ziemowit coal mine with the use of bent ray seismic passive tomography.

Abstract

The dissertation presents novel method to estimate current seismic hazard level in Ziemowit coal mine with the use of modern seismic monitoring system and advanced techniques of passive tomographic imaging. Application of passive tomographic imaging to determine short period seismic hazard assessment was not feasible until now due to the lack of proper installation of underground seismic network to record sufficiently large amount of seismic events together with appropriate application of seismic tomographic algorithm. Therefore all previous passive tomographic images have been obtained for seismic events recorded in a few months time periods. Analysis of these tomographic images allowed only to acquire information on seismic hazard level in a relatively long time periods. Hence it was not possible to monitor seismic P wave velocity changes in shorter time periods related to continuous monitoring of seismic hazard during the mining process. Using specifically designed and installed modern microseismic observation system SOS in Ziemowit mine it was possible to significantly increase the number of recorded seismic events and use them to perform short period 4D tomographic imaging. Bent ray passive tomography method utilizes modern nonlinear optimization algorithm with regularization that significantly increases the reliability of the tomographic results. The use of very sensitive underground seismic network has allowed for recording low-energy seismic tremors throughout the mine area and made it possible to utilize in tomographic calculations seismic events with seismic energies of the order of $10^2 J$ or higher.

Specifically designed underground seismic network and 4D passive tomographic imaging were used to show that modern microseismic monitoring system makes it possible to assess short period seismic hazard during longwall mining in the Ziemowit coal mine. Detailed analysis of 85 tomographic images reflecting changes of seismic P wave velocity in the analyzed area was conducted. In this way, practical aspects of the problem of continuous tomographic monitoring and seismic hazard assessment were presented.