Geophysical Research Abstracts
Vol. 17, EGU2015-11884, 2015
EGU General Assembly 2015

Application of MASW method in studies on changes of soil elastic parameters over subsidence trough development during longwall exploitation

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The MASW method interpretation was applied to analyze 37 measurements which had been carried out to investigate spatial and temporal changes of elastic parameters in subsurface layers during extracting the coal bed. The seismic measurements were performed using the Terraloc apparatus containing 12 channels connected with 10 Hz geophones. 5 survey profiles were formed into a rosette with arms arranged relative about 45 degrees to each other. The research area was located in the Main Anticline, Upper Silesian Coal Basin, Southern Poland. The rosette was placed over the 201 longwall belonged to "Katowice - Kleofas" Coal Mine. Shallow geological structure consisted of subsurface soft layer (several meters) covered consolidated Carboniferous complex. Data interpretation were executed in winMASW software using the genetic algorithms to invert observed Rayleigh dispersion curve into S-wave velocity vertical profiles. In addition, the inversion allowed to determine parameters such as: density, thickness, shear modulus.

The seismic study were carried out during total exploitation of the coal bed and for next 8 month after completion of mining works. Longer seismic observations than the mining works were due to a subsidence trough development over coal bed because the longwall face passage and subsidence trough development were shifted in time and it reached about 3 month. This time was needed to appear the subsidence trough on surface what was confirmed by leveling measurements. The longwall face had passed beneath the rosette in December, 1999 and in March, 2000 a sharp velocity drop on each profile was noticed. Next, a sudden velocity increase appeared in subsurface layer after the velocity drop. The changes of density and shear modulus was also remarked during the same period. At the beginning the sudden drop in velocity and other elastic parameters was associated with tension appeared on borders of subsidence trough. Then the geophysical profiles were in the compressive forces area causing an increase in the elastic parameters of the ground. After this process such abrupt changes stopped and all measured parameters either remained generally unchanged or decreased slowly. Some fluctuations were noticed, but probably they resulted from changes in groundwater levels which might affect the elastic parameters.

The measurements also indicated the spatial changes of elastic parameters. Some directions on the rosette could be distinguished during the formation of subsidence trough border. The results for soft layer showed main direction of S-waves and shear modulus anisotropy. It occurred in major cases in NNW-SSE direction. Several example of N-S directions could be found and this direction was perpendicular to the longwall face passage. Before and after the formation of subsidence trough border below the rosette the isotropy in geology was mainly observed. The differences were only found in values, elastic parameters were small before and became larger after.