

## ABSTRACT

A growing number of seismic events with energies greater than  $1\text{E}+06$  J recorded in recent years and the number of registered tremors and rockbursts results in the risk of rockbursts becoming the dominant threat to occur in the mines of the Upper Silesian Coal Basin. Due to the ambiguous mechanism of rockbursts formation and the limited scope of observation by individual measurement methods in coal mines to assess this risk, in accordance with the guidelines of the Central Mining Institute (Barański et al., 2012), a comprehensive method is used. Currently used basic geophysical methods, i.e. seismological and seismoacoustical are mainly based on a back analysis of seismic phenomena. High seismic activity due to imbalance in complicated tectonic structures, as a result of previously and currently conducted exploitation, forces the need for continuous improvement of the methods of risk assessment.

In this study, an attempt was made to determine the relationship between the registered seismic activity, geological and mining conditions in the area of works carried out, and changes in the mechanisms of seismic tremors and spectral parameters. The research was carried out for three independent research areas (mining longwalls) characterized by different mining and geological conditions, i.e. for:

- longwall 577a in deck 510, in part B, bay B1 (PGG S.A. KWK Mysłowice-Wesoła),
- longwall 413 in deck 416, in part A West (PGG S.A. KWK Mysłowice-Wesoła),
- longwall 310 in deck 507, in the Central part (PGG S.A. KWK Ruda, Ruch "Bielszowice").

For selected shocks recorded in the above areas, focus mechanisms and spectral parameters were determined using the *FOCI* program (Kwiatk, 2019). The seismic signal exported from the *ARAMIS* system software was processed into a format supported by the *FOCI* program, using the *HESTIA D* dispatcher program (Mazik et al., 2016).

The obtained solutions of the mechanisms of formation of foci of mining tremors (directions of the nodal planes, the percentage share of individual components) as well as the gained spectral parameters characterizing the tremors to a large extent explain the genesis of their formation. As a result of the conducted analysis, the correlation between the changes in the focal mechanism and selected spectral parameters (seismic moment, apparent stress and stress drop) of the rock tremors foci was shown to be dependent on the seismic hazard resulting from geomechanical changes of the rock. Additionally, the conducted analysis showed that the TMS method allows a more accurate determination of the depth of tremor foci.

On the basis of the analysis of changes in the mechanisms of tremors foci registered in selected test sites, taking into account their hypocentral depth and the existing geological and mining conditions, qualitative criteria for assessing the risk of rockbursts and tremors in the area of mining works in the longwall system were developed. On the strength of the determined spectral parameters, a universal quantitative criterion for the assessment of the risk of rockbursts was developed based on the calculated value of the seismic moment, stress drop and apparent stresses. The proposed evaluation criteria were adapted to the seismological method of rockbursts risk assessment, treating them as an extension of the criteria set out in the GIG instruction no. 22 (Barański et al., 2012).

In order to verify the obtained results, the designated risk assessments were compiled with ratings obtained according to the commonly used criterion based on the tremors energy.

As a result of the conducted observations and analysis, it has been shown that the assessment of the threat state, enriched with the proposed evaluation criteria, is a constructive supplement to the seismological method and a broader look at the factors influencing the state of danger in the area of mining works.