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Prediction of ground motion due to mining seismic activity: a general prediction scheme applied to assess impacts on tailings pond in Legnica-Glogow Copper District in Poland in the years 2011-2050

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Copper-ore excavation in the Legnica-Głogow Copper District (LGCD) in south-west Poland is accompanied by intense induced seismic activity. In-mine seismic systems record altogether thousands events annually, whose local magnitude ranges from 0.4 to 4.5. Within a range of mining tremors impact is the Zelazny Most tailings pond, one of the largest waste dumps in the world. To ensure its safety a probabilistic seismic hazard analysis (PSHA) is performed every few years and its results are used to adjust mining plans. In this work we present the newest predictions of limits of ground motion at the Żelazny Most pond embankments for the period 2011-2050.
A seismic process in mines is controlled predominantly by time-varying mining works, therefore the results of PSHA for mining induced seismicity are predictions related to a prescribed time period in the future. Here, ground motion has been parameterized by peak horizontal and peak vertical acceleration and the exceedance probability of the limit is 5 per-cent. The work is done in a general prediction scheme. The expected seismic excitation is linked to the continuation of mining in LGCD. Based on mining plans 84 seismic zones, expected to become active in the years 2011-2050, have been identified and their periods of activity have been established. Seismic activity associated with past and current mining works is used to choose alternative models of event rate and event size distribution for the seismicity in the zones of future activity. Analyzing mining seismic catalogs, 188 zones active in the past and/or at present have been singled out and their probabilistic characteristics have been determined. It is assumed that the a priori probability of a model to be followed in a future zone is inversely proportional to the distance between the past zone, which originated the model, and the future active zone. As an epicenter distribution in future zones, the 2D uniform distribution is assumed, supposing that tremors may also occur within up to 100 m from the planned excavation area. More than 2700 three-component ground motion signals collected in the study area since 2002 has been used to work out appropriate local ground motion prediction equations. In these equations, relative local amplification factors are also taken into account. The hazard analysis is performed in a full probabilistic way, in which uncertainties associated with each step are represented by appropriate probabilistic distributions, and alternatives are dealt with in a logic-tree scheme.