



Complex source mechanisms of mining-induced seismic events - implications for surface effects

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The seismicity of Legnica-Głogów Copper District (LGCD) is induced by mining activities in three mines: Lubin, Rudna and Polkowice-Sieroszowice. Ground motion caused by strong tremors might affect local infrastructure. "Żelazny Most" tailings pond, the biggest structure of this type in Europe, is here under special concern. Due to surface objects protection, Rudna Mine has been running ground motion monitoring for several years. From June 2010 to June 2011 unusually strong and extensive surface impact has been observed for 6 mining tremors induced in one of Rudna mining sections. The observed peak ground acceleration (PGA) for both horizontal and vertical component were in or even beyond 99% confidence interval for prediction. The aim of this paper is analyze the reason of such unusual ground motion.

On the basis of registrations from Rudna Mine mining seismological network and records from Polish Seismological Network held by the Institute of Geophysics Polish Academy of Sciences (IGF PAN), the source mechanisms of these 6 tremors were calculated using a time domain moment tensor inversion. Furthermore, a kinematic analysis of the seismic source was performed, in order to determine the rupture planes orientations and rupture directions. These results showed that in case of the investigated tremors, point source models and shear fault mechanisms, which are most often assumed in mining seismology, are invalid. All analyzed events indicate extended sources with non-shear mechanism. The rupture planes have small dip angles and the rupture starts at the tremors hypocenter and propagates in the direction opposite to the plane dip. The tensional component plays here also big role. These source mechanisms well explain such observed strong ground motion, and calculated synthetic PGA values well correlates with observed ones.

The relationship between mining tremors were also under investigation. All subsequent tremors occurred in the area of increased stress due to stress transfer caused by previous tremors. This indicates that preceding tremors contributed to the occurrence of later ones in the area.

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