

The relation between blasting mining operations and catastrophic anthropogenic earthquakes in Kuzbass

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The territory of Kuzbass is remarkable because of the enormous (up to 700 billion tons) and near-surface (from the surface to the depth of 2 km) reserves of high-quality coal, coking coal for the most part, which also has a relatively low sulfur content (5-10 times lower than in the Donbass for example) and lastly can be produced not only in mines, but quarries. High demand for this type of coal is the reason why its production in Kuzbass is growing annually and lately reached a record value of 300 million tons per year.

With this said, the quantities of explosives used for mining are increasing annually as well, currently exceeding 800 thousand tons per year, i.e. almost half of the annual consumption of industrial explosives in the country. The massive extraction of coal, the extra load of waste rock, regular vibrations caused by drilling processes and moving vehicles, numerous borehole explosions that causes severe dynamic impact on the massif; All of those factors caused a restructure in the massif's stress-strain state. Such a change in the stress state of the hierarchical block-structure of the array is accompanied by the genesis of focal stress zones that occur in inhomogeneities, rifts and interblock boundaries.

The combination of increasing anthropogenic load and naturally high seismic activity of the Kuzbass massifs' depths results in a significant increase of anthropogenic seismic events in a wide range of magnitudes; From the weakest earthquakes to strong anthropogenic seismic events with a regional magnitude of m_b more than 3, typically accompanied by emission more than 1GJ of seismic energy.

In this paper, based on the analysis of the twenty-year period data (1998-2018) from international seismic catalog ISC, the correlation between changes in the quantities of explosives used for mining and the number of strong anthropogenic earthquakes is established, earthquakes with magnitudes of m_b more than 3-4 up to catastrophic m_b more than 4,5-5 (ex. 18.06.2013 Bachata earthquake, $m_b=5,8$).

The established correlation between increasing numbers of severe anthropogenic earthquakes and blasting mining operations, indicates that current stress state of Kuzbas depths formed by external technological factors can be destabilized by large-scale explosions and trigger the discharge of the stress in the form of powerful anthropogenic earthquakes.