

Regularities of increase and decrease of trigger seismicity in the rock mass during the mining of the Lovozero rare metal deposit

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The Lovozero deposit is one of the most geodynamically hazardous in Russia. The most powerful mining-induced geodynamic event in the entire history of Russian mines and open pits had taken place here: a tectonic rockburst at the Umbozero mine had occurred on August 17, 1999, magnitude $ML = 5.1$, energy class $k = 11.8$. This event had been established to be caused by the simultaneous excavation of two flat-dipping contiguous ore deposits developed by mining methods with an open space in a highly tectonically stressed rock mass.

In the 90s of the last century, during the Umbozero mine exploitation, the seismicity of the Lovozero deposit, both in the number of strong seismic events ($ML > 1$) and in their energy, exceeded the seismicity of the neighbouring Khibiny apatite-nepheline deposit, although the volume of mining at the latter were ten times more. This fact indicates that mining-induced trigger seismicity is caused, first of all, by natural and not mining factors.

Currently, the Lovozero deposit is being operated by the Karnasurt mine, which produces two thin (1.2 m each) flat-dipping (angle of incidence $10-15^\circ$ to the horizon) closely spaced (distance between deposits in the vertical is 90-110 m) ore bodies in highly tectonic stressed rock mass. The Umbozero mine has been abandoned for 10 years.

The seismicity of the Karnasurt mine in 2002-2015 was quite high (up to 10 strong events $ML > 1.0$ per year). At the moment, there is a decrease in seismic activity of the mine's rock mass. In recent years, no more than 1-2 strong events ($ML > 1.0$ per year) occur. The number of weak seismic events ($E = 10^3-10^4$ J) in the rock mass decreases from year to year: in 2016, an average of 26 events per month was recorded, in 2017 - 11 events per month, in 2018 - 8 events per month. Not a single strong seismic event was registered in the mine in 2018. In our opinion, the weakening of the seismic activity of the Karnasurt mine rock mass is due to the fact that recently there has been no development of the upper contiguous ore body over the mined part of the lower ore body. Thus, there are no significant interblock movements of the rock mass induced by mining.