

## Development of the seismic monitoring system at Verkhnekamskoye potash deposit

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One of the most important tasks in underground mining of potash is protecting mining revenue from groundwater. To ensure the safe operation of mines at Verkhnekamskoye potash deposit a comprehensive complex of monitoring observations is used. A significant part of this complex is the seismological monitoring.

At the moment, an advanced seismic monitoring system is operating on the territory of Verkhnekamskoye deposit. It allows to monitor geodynamic activity in near real time mode. This system includes three hierarchical levels: regional, local and detailed.

The regional level is focused on the registration of earthquakes with magnitude  $ML > 1$ , occurring in the entire Verkhnekamskoye deposit. The local level is represented by mine monitoring systems covering all exploited mine field. Detailed level represented by a systems for monitoring emergency zones or potentially hazardous areas. The size of these areas usually not exceeds a few hundred meters. Range of representatively registered magnitudes for these systems starts with  $ML = -2$ . Hierarchical levels aren't independent, and the data of each of them may be used for the processing of the results of monitoring at any of the objects.

Detailed seismological monitoring acquired special urgency after the flooding of the BKRU-1 mine. Most of the city of Berezniki numbering more than 150 000 inhabitants is located on the undermined territory. Flooding of mine led to the formation of several sinkholes and areas of high-speed subsidence at the surface. Seismic monitoring allows to observe the development of negative processes in near-real time mode and to somewhat predict them. Currently, 7 systems of detailed monitoring that control the most dangerous areas are installed over mine openings of BKRU-1 mine.

Seismological monitoring also has proven its effectiveness in monitoring of the evolution of an emergency situation at Solikamsk-2 mine. Sensors of the local monitoring network detected the fact of the destruction of the waterproof strata and the breakthrough of waters in the mine openings. Promptly deployed a detailed monitoring system enabled to monitor the emergency and ensure the safety of workers engaged in the liquidation of the accident.

Thus, on the territory of Verkhnekamskoye potash deposit at the moment operating an integrated system of near real-time seismic data acquisition and processing. It includes three hierarchical levels and allows solving problems of safety of mining operations with high efficiency.