The trigger effect research in a shock-hazard rock massif by laser interferometry

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The high intensity of mining at the mines of PJSC Priargunskoye Mining and Chemical Association led to the formation of an extensive zone of technogenic disturbance of the geological environment, which was one of the reasons for the activation of geodynamic processes in the rock mass containing the developed fields.

The results of rock pressure during the development of deep horizons of deposits occur together with the high modern geotectonic activity of the region.

For complex scientific research of geodynamic and seismic state, at the fields of PJSC PIMCU, a number of academic institutes created and improved a multi-level integrated geodynamic monitoring system, combining seismic, geoacoustic and deformation methods and measuring complexes into a single measuring network.

As part of the creation of a multi-level integrated geodynamic monitoring system in the Streltsovsky ore field area in 2012, a 50-meter laser deformograph was installed.

It is located in an underground mine at a depth of more than 300 m. The optical part of the deformograph is based on a modified Michelson interferometer of unequal arm type with a working arm length of 50 m, oriented to the north-east at an angle of 30°, and a frequency-stabilized laser from MellesGriott. The interferometer is able of detecting displacement of the earth's crust with an accuracy of 0.1 nm in the frequency range from 0 to 1000 Hz.

Processing the results of the deformograph measurements is carried out using the program "DEFORMOGRAF". The results of measurements of the deformograph are presented in the following form.

1. Dependence of the deformograph base displacement from time, which allows us to estimate the long-period variations of the acoustic field.

2. The spectral characteristic of the signals obtained by processing the time dependence of the offset.

3. Dynamic spectrogram, which illustrates the behavior of the spectral components of the signal over time.

To evaluate the effect of explosive effects on the deformation field in the region of the laser deformograph, a series of experimental explosions was performed. The results obtained indicate that the size of the effective monitoring zone of the deformograph is at least 10 km across.

At the 2-week recording of the deformograph, diurnal and semi-diurnal tidal fluctuations (the magnitude of which is 23 h 18 min and 11 h 53 min, respectively) are highlighted.

According to the results of data processing, the characteristic spectrum of the Earth's natural oscillations range from the main spheroidal tone 0S2 to another main spheroidal tone 0S0 was revealed.

In accordance with the results of scientific research using a laser deformograph, a laser nanobarograph and a multichannel automated geoacoustic monitoring system for rock pressure, seismic waves from distant earthquakes and blasting operations initiate geodynamic processes and affect the state of the rock mass. This is indicated by the presence of characteristic sharp displacements in the recording

of the deformation signal and an increase in the number of events with an increase in their energy, recorded by the geoacoustic system sensors.