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Research the dynamical characteristics of slow deformation waves as a rock massif response to explosions during its outworking

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As a result of long-term natural geomechanics and geophysical observation data on mines of complex ore rocks, generalization of the non-linear reaction of rock massif to heavy dynamic influences have been established. In addition, pendulum type waves have been observed and the sources of them have been located inside geoblocks of different hierarchic levels (Oparin et al., 2010). At the same time, these waves propagate with wide low (compared with seismic waves) velocity values (Kurlenja et al., 1993; Oparin et al., 2006). Research into the massif state with the use of the dynamic systems theory approach (Naimark et al., 2009; Chulichkov, 2003; Hachay et al., 2010) has been developed to ascertain the criteria of dissipative regimes changing for real rock massifs, which are under heavy man-caused influence. To realize such research we used the data from the seismic record of the Tashtagol mine for the two-year period from June 2006 up to June 2008. We used the space–time coordinates for all dynamic massif event responses, which occurred during that period inside the mine space and for the explosions – values fixed by seismic station energy (Hachay et al., 2010). The phase diagrams of the massif state for the northern and southern parts of the mine space were plotted in coordinates Ev(t) and d(Ev(t))/dt, t – time – in parts of 24 hours, Ev – the dissipated massive seismic energy – in joules. Hachay et al., (2010) analysed the morphology of seismic response phase trajectories on the explosion influences during different serial intervals in the southern part of the mine. In that period, according to data for different explosions in the mine, the majority of the total energy had been injected into the southern part of the mine. Moreover, at the end of 2007, just in the southern part, the strongest rock burst during the whole history of the working mine happened. We developed a new processing method of seismological information in real, which we can use directly in the mine to estimate the changing state of the rock burst in the massif by its outworking. As a result we have selected a typical morphology of massif response phase trajectories, which were locally, over time, in a stable state: on the phase plane the local area presented as a ball of twisted trajectories with some not far removed points from the ball, which had not exceeded energy of more than 105 joules. For some time intervals those removed points exceeded 105 joules, achieving 106 joules and even 109 joules (Hachay et al., 2010). Introduction of the additional velocity parameter of slow deformation wave propagation allowed us, with the use of phase diagrams, to identify the hierarchic structure. Further, we can use that information for the modelling and interpretation of seismic and deformation waves in hierarchic structures (Hachay et al., 2012). That method can be useful in building-up an understanding of the resonance outshooting of catastrophic dynamic events and prevent these events. References 1.Chulichkov A. (2003) Mathematical models of nonlinear dynamics. Moscow: Phismatlit. 294p. 2.Hachay O., Khachay O.Yu., Klimko V., et al. (2010) Reflection of synergetic features of rock massif state under the man-caused influence from the data of a seismological catalogue. Mining Information-Analytic Bulletin, Moscow, Mining book, 6, pp.259–271. 3.Hachay O., Khachay A.Yu. (2012) Research of stress-deforming state of hierarchic medium. Proceedings of the Third Tectonics and Physics Conference at the Institute of the Physics of the Earth 8–12 October 2012, Moscow, IFZ RAS, pp.114–117. 4.Kurlenja M., Oparin V., Vostrikov V. (1993) About forming elastic wave trains by impulse excitation of block medium. Waves of pendulum type $U\mu$. DAN USSR, V.133, 4, pp.475–481. 5.Naimark Yu., Landa P. (2009). Stochastic and chaotic oscillations. Moscow, Knigniy dom ,"LIBROKOM", 424 p. 7.Oparin V., Vostrikov V., Tapsiev A. et al. (2006) About one kinematic criterion of forecasting of the limiting massif state with use of seismological data , FTPRPI, 6, pp.3–10.