Hysteresis model of accumulation and discharge of seismic energy in the geological environment

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The development of mineral deposits is associated with the production of mining operations, which, at the present level of development of engineering machines and technologies, have a significant impact on the surrounding space. To prevent the negative consequences of this influence, it is necessary to take into account at the model level the effects of absorption and accumulation of deformation energy of rocks. One of the possible approaches to solving the aforementioned problem is connected with the use of constructive hysteresis models, which, after determining their parameters, identify the energy state of the surface layer of the Earth's crust, which, in turn, will make it possible to assess the risks of seismic events associated with man-made earthquakes. The paper presents a hysteresis model of accumulation and discharge of seismic energy (due to explosive work) in the geological environment.

The proposed model is based on the operator interpretation of hysteresis transducers. With their help, the relationships between the dynamic parameters describing the state of the geological environment are established at the quantitative level. The Converter used is static (properties do not change over time), deterministic (the state at each moment is determined by the output-input values), controlled. The static nature of the transducer in relation to the problems of seismology means the correct determination of the reaction of the geological environment to the step effect formed by the Heaviside function.

A mathematical model based on the Ishlinsky-Prandtl transducer, which is a continuum analog of the family of stops with different yield limits connected in parallel. The Ishlinsky- Prandtl transducer describes the relationship between stress and strain in geological media. Note that the hysteresis loop of this transformation is bypassed clockwise (negative spin) - that is, when it is bypassed, the energy is released.

The proposed model, according to the authors, adequately describes the rather complex seismic processes of energy accumulation and unloading in the upper part of the earth's crust.