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Mathematical modeling of geodynamic activity in the framework of blocky rotational model of geomedium motion

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The paper shows that the motion of geomedium in the framework of rotational model follows the law of angular momentum conservation and can be described by classical elasticity theory with symmetric stress tensor. The motion of geomedium is characterized by two types of rotational waves with short- and long-range actions. The first type is slow solitons with velocities $0 \leq V_{sol} \leq$1-10 cm/s. The second type is fast excitons with velocities $V_0 \leq V_{ex} \leq V_S \div V_P$. The minimum velocity of excitons V_0=0 is determined by energy of "collective" excitation of all blocks in seismic belt. This energy is proportional to the pole oscillation frequency (Chandler frequency). The maximum velocity of excitons is determined by velocities of S ($V_S \approx$4 km/s) and P ($V_P \approx$8 km/s) seismic waves.

The study of temporal regularities of geodynamic process within tectonically active regions showed the existence of common geodynamic period $T_0 \approx$250 years. To investigate the spatial and temporal patterns of the geodynamic process we constructed the mathematical model of migration of earthquakes foci and volcanic eruptions. The model is based on the description of the seismic and / or volcanic processes as the combination of one-dimensional sequences of events taking place along the axial line of the belt during the given period. Data obtained allows considering the migration process as a characteristic property of seismic and volcanic activity of the Earth. We proposed the wave model of geodynamic process, which is based on concepts of migration and cyclicity of seismic and volcanic activity, and the persistent vector parameter which is "sensitive" to the tectonic setting in the active zone.

The modified sin-Gordon equation is used to describe "collective" wave motion of earth's crust elements in the framework of blocky rotational model. We conducted a numerical investigation of its soliton solution dynamic parameters. The obtained results are consistent with regularities of seismic process and concept of geodynamic activity migration that allows us to interpret migration process as wave energy transfer in the earth's crust with two characteristic types of excitation: slow solitons, described by soliton solution of sin-Gordon equation, and fast excitons. It is shown that new model of wave geodynamic process allows, among other things, to quantify basic properties of seismic process in the earthquake focus: foreshock and aftershock stages and the main shock between them.