Modeling the influence of small tangential gravitational forces on the global stress field

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The search for the entire set of forces responsible for the movement of lithospheric plates is an important task of modern global geodynamics. In the study of various geodynamic factors responsible for the formation of supralithostatic stresses in the lithosphere, much attention has recently been paid to the shape of the base of the lithosphere as a surface whose current position, minus the isostatic component, is associated with flows in the asthenosphere and upper mantle. In some works, the question of the formation of tangential forces on the mantle sole is considered separately [1]. One of the sources of additional stresses in the lithosphere, not directly related to mantle convection, can also be considered the influence of the shape of the physical surface of the Earth (PPS), namely, additional small tangential gravitational forces that arise in the gravity field due to the difference between the PPP and the geoid surface. This difference is usually considered as insignificant in the context of the formation of a global stress field, however, according to the results of studies, some of which are presented in this paper, the amplitudes of stresses associated with the considered tangential forces can reach the first MPa, which over long time intervals can make a significant contribution to the overall picture. global tectonics. A more detailed description of this study is presented in [2]. Detailed relief maps (from 0.5° to 5') and the geoid from the EGM 96 model were used in the work. The plumb line angle (PLE) was considered as the main parameter under study. On the basis of the obtained SLE values, the values of the stresses generated in the lithosphere were then calculated. The apparatus of spherical functions was used to calculate the distribution associated with the deviation of the shape of the PTF from the geoid of the RFE, which makes it possible to obtain the desired averaging scale. The amplitudes of tangential mass forces for each point of the Earth's surface are obtained, and the forces acting on individual plates are shown.

It is shown that tangential body forces can create normal horizontal stresses of a level of 10 MPa and higher that are quite significant in amplitude. In [2], the problem is discussed that, when integrated over depth for the lithosphere as a whole, the maximum shear stresses can exceed values in the first tenths of MPa and, therefore, the considered tangential body forces can be an independent source of plate movement. For individual plates, such as the Amur or Okhotsk, this factor is especially significant.

Bibliography:

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